ERIC Document Resume	See Instruction Sheet	DATE OF RESUME	DATE RECEIVED

A. PUBLICATION DATA

1. ERIC NUMBER ED002384

2. ORIGINATOR CONTROL NO(S). N.A.

3. IDENTIFICATION NO. CR-1493

4. AUTHOR(S): Renning, Royce R. and others

5. TITLE OF DOCUMENT ABSTRACTED:

Application of Multidimensional and Scale Analysis to Interest Measurement

6. PUBLICATION TITLE: N.A.

7. EDITOR(S): N.A.

8. PLACE OF ORIGIN

ORG. University of California

ST. Berkeley, California

CITY, STATE

TELE. EXT

INST/LOC CODE

9. PUBLISHER OR SOURCE Cooperative Research Program, Office of Education, Dept. of Health, Education, and Welfare, Wash.,D.C

10. VOL.	11. PAGES	12. MO./YR.	13. TOTAL PP.
N.A.	N.A.	1963	157

DO NOT WRITE IN SPACE BELOW

MICROFILM COPY AVAILABLE

YES ☒ NO ☐

COPYRIGHT GRANTED

YES ☐ NO ☒

COPYRIGHT RELEASE FILED

YES ☐ NO ☐

TYPE OF REPORT

PROPOSAL ☐

IN-PROGRESS ☐

FINAL ☒

FOLLOW-UP ☐

OTHER ERIC REFERENCES:

ERIC SATELLITE CODE

B. INDEXING DATA

14. SUBJECT AREA

15. TYPE OF ENDEAVOR Report

16. INDEXING TERMS (6-12)	vocation interests	noncognitive attributes	vocational guidance
student interests	interest research	factor structure	guidance counseling
interest testing	interest measurement	interval scaling	
	measurement	interest scales	

17. ABSTRACT (MAX. 250 WORDS)

Research is directed toward finding a method to improve existing instruments for measurement of noncognitive processes by use of an equisection technique to develop scales of current educational-vocational interests.

Factor structure developed was a modification of Cottles' interest items and was based on empirically or rationally developed keys. Interval scaling, using the technique of Gardner and Thompson, was attempted. To test the success of these approaches, the following were sought: stability of the factor structure and similarity for two independent samples; similarity of the factor structure by an equisection technique to paired comparison technique; differences of factor structure between item categories; and ways information from disparate areas can be utilized. Junior college students were used as subjects. Computational formulae developed by Box were used. Wilks' statistic was used.

Results substantiate the hypothesis that interests can be measured by equisection procedure with resulting scales having quite satisfactory test-retest reliability. Measurement tests using such scales will be amenable to a wider variety of analysis than scores from other types of interest scales. The reliability of the scales has important implications for the development of scales of noncognitive attributes other than interest. Many existing scales can be reduced in length by using this measurement instrument. Despite the encouraging results from this initial effort, much remains to be done before it will be available for distribution as a research tool. Revisions made from this study will need additional samples in terms of sex, age, and educational and ability levels. Complete analysis tables and an appendix accompany the text.

ERIC No.

18. SOURCE OF ABSTRACT

C. FUNDING DATA

19. SUPPORTING ORGANIZATION

20. DIVISION OR DEPT.

21. CONTRACT NO.

PROJECT NO.

22. TOTAL COST OF PROJECT

23. DURATION OF PROJECT

U.S. Department of Health,
Education, and Welfare
Office of Education

ERIC Form 1

APPLICATION OF MULTIDIMENSIONAL AND SCALE ANALYSIS TO INTEREST MEASUREMENT

Cooperative Research Project No. OE 1493

Royce R. Ronning
Walter R. Stellwagen
Lawrence H. Stewart

U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
Office of Education

This document has been reproduced exactly as received from the person or organization originating it. Points of view or opinions stated do not necessarily represent official Office of Education position or policy.

University of California
Berkeley 4, California

1962 - 1963

The research reported herein was supported by the Cooperative Research Program of the Office of Education, U. S. Department of Health, Education, and Welfare.

ED002384

ACKNOWLEDGEMENTS

We wish to express our appreciation to the Administrative and Counseling Staffs of the following colleges for their assistance in obtaining the subjects for this study:

Diablo Valley College

Foothill College

Chabot College

Oakland City College
(Laney and Merrit Campuses)

San Mateo College, and

Santa Rosa College

We are especially grateful for the efforts of the assistants associated with the project. Manford J. Ferris served as Programmer and supervised the data analysis. Miss Lenora Crain and Mrs. Mary Smith helped with the data collection and with the preparation of data for analysis. Mrs. Thelma Behrens, Secretary for the project, also assisted with many aspects of the data analysis.

R.R.R.
L.H.S.
W.R.S.

CONTENTS

Page

ACKNOWLEDGEMENTS ii

LIST OF TABLES iv

LIST OF FIGURES v

PROBLEM . . . . 1 - 3

OBJECTIVES . . . . 4 - 5

RELATED RESEARCH . . . . 6 - 18

PROCEDURE . . . . 19 - 40

ANALYSES OF THE DATA AND THE FINDINGS . . . . 41 - 81

CONCLUSIONS AND IMPLICATIONS . . . . 82 - 85

REFERENCES . . . . 86 - 88

APPENDICES

A. Description of Project Study Accompanying Original Contract Application . . . . A1 - A15

B. Experimental Instrument Form II . . . . B1 - B11

C. Canonical Correlation Analyses of Original Interest Areas . . . . C1 - C5

D. Correlation of Items Within a Factor With Factor Total . . . . D1 - D8

E. Correlation of Items With Factor Totals . . . E1 - E6

LIST OF TABLES

Table		Page
1	Wilks' Test for Equality of Covariance Matrices of Two Randomly Selected Subgroups of Original Subjects	42
2	Canonical Correlation for Test-Retest Reliability Over Five-Week Interval	51
3	Test-Retest Correlation for Items and for Factor Totals	68
4	Wilks' Criterion Test for Parallel Items for Factors	70
5	First Canonical Correlation Coefficient for all Item Categories	44
6	Second Canonical Correlation Coefficient for all Item Categories	45
7	Third Canonical Correlation Coefficient for all Item Categories	46
8	Fourth Canonical Correlation Coefficient for all Item Categories	47
9	Fifth Canonical Correlation Coefficient for all Item Categories	48
10	Sixth Canonical Correlation Coefficient for all Item Categories	49
11	Magnitude of Canonical Correlation Coefficients Required for Significance at the .01 and .05 Levels Based on Kullback Test for Original Sample of 188 Subjects	74
12	Canonical Correlations for Paired Comparison and Area Analysis	76
13	Canonical Correlation for Areas, Factor Total and SVIB	78
14	Canonical Correlation for Areas, Factors and Kuder . . .	80

LIST OF FIGURES

Figure		Page
1	Area I of Experimental Instrument Form II	33
2	Plots of Loadings for Canonical Variates 1 and 2 from Interest Areas 4 and 7	52
3	Plots of Loadings for Canonical Variates 1 and 3 from Interest Areas 4 and 7	53
4	Plots of Loadings for Canonical Variates 1 and 4 from Interest Areas 4 and 7	54
5	Plots of Loadings for Canonical Variates 1 and 5 from Interest Areas 4 and 7	55
6	Plots of Loadings for Canonical Variates 1 and 6 from Interest Areas 4 and 7	56
7	Plots of Loadings for Canonical Variates 1 and 2 from Interest Areas 6 and 7	57
8	Plots of Loadings for Canonical Variates 1 and 3 from Interest Areas 6 and 7	58
9	Plots of Loadings for Canonical Variates 1 and 4 from Interest Areas 6 and 7	59
10	Plots of Loadings for Canonical Variates 1 and 5 from Interest Areas 6 and 7	60
11	Plots of Loadings for Canonical Variates 1 and 6 from Interest Areas 6 and 7	61
12	Plots of Loadings for Canonical Variates 1 and 2 for Scores Summed for the 12 Factors	62
13	Plots of Loadings for Canonical Variates 1 and 3 for Scores Summed for the 12 Factors	63
14	Plots of Loadings for Canonical Variates 1 and 4 for Scores Summed for the 12 Factors	64
15	Plots of Loadings for Canonical Variates 1 and 5 for Scores Summed for the 12 Factors	65
16	Plots of Loadings for Canonical Variates 1 and 6 for Scores Summed for the 12 Factors	66

PROBLEM

PROBLEM

Research activity in the area of interest measurement has been restricted largely to the study of Strong's Vocational Interest Blank (SVIB) and Kuder's Preference Record (KPR). The value of these instruments in vocational and educational counseling has been demonstrated in many studies. However, most of the interest research to date has been directed toward determining the nature of variables measured by the SVIB (1938) and the KPR (1956), and toward developing better procedures for interpreting these instruments. With few exceptions (e.g., Clark, 1961; and Gee and Clark, 1956) little effort has been devoted to the development of new and more adequate measures of interests or to attempts to improve the existing instruments by examining their scale properties. Actually, during the past 35 years, scaling aspects of interest measures appear to have been largely ignored by measurement specialists.

The entire field of interest measurement is in need of careful examination. Unfortunately, existing instruments provide a questionable basis for such examination. Both the SVIB and the KPR are more than 25 years old, and both (particularly the Strong Blank) are in need of revision. Many items on the SVIB are dated to the point that they are no longer recognized by the current generation. Also, changes in the occupational structure since the development of the scales may mean that the original occupational criterion groups are no longer appropriate. Kriedt's study of psychologists (1949) would indicate this is so. Surprisingly enough, practically no studies have been devoted to the problem of interest change within occupational groups as a function of time.

In view of the widespread use of interest measures in counseling and guidance, it seems particularly appropriate at this time to examine some of the scaling properties of interests. Such examination could provide information essential for the revision of existing instruments as well as for developing new and, perhaps, more effective instruments than those which are now available.

Two common practices in the measurement of non-cognitive processes, such as interests, values, and personality characteristics, are of central concern in this study. First is the combination of a group of heterogeneous items into a scale on the basis of empirically or rationally developed keys. Examples of such scales are the subscales of the Minnesota Multiphasic Personality Inventory (MMPI), the KPR, SVIB, etc. While these scales have some internal consistency, the factor structure of the items has not been considered explicitly in the process of scale development. Frequently, little information is available as to the rationale for the items included in a particular scale other than that the items have internal consistency or that they differentiate among criterion groups; thus, extrapolations from specific validity data, often required in counseling, become exceedingly difficult. On the KPR, for example, a wide variety of items with a common referent, e.g., science, simply are added. No attention is given to possible differences in factor structure between different item categories, such as hobbies, job titles, or characteristics of people.

A second common practice in measurement of non-cognitive factors is the use of arbitrary integer weights (most commonly 0 and 1) for weighting individual items. Recently, however, Gardner and Thompson (1956) successfully applied bisection scaling techniques to the measurement of social relations and are applying it to values. This is of great significance because their efforts represent one of the few successful attempts at interval scaling in the measurement of non-cognitive factors. If techniques such as those used by Gardner and Thompson can be successfully applied to the interest domain, it may be possible to investigate certain aspects of the scaling properties of interest measures which have heretofore been largely neglected by measurement specialists.

Two major problems underlie the present study. First, can scaling procedures resulting in interval scales be applied to the interest domain? The successful application of such procedures would provide a better basis for weighting items than the somewhat arbitrary bases now employed. Second, is it appropriate to combine items from disparate content areas into a given scale? Findings relative to this problem will have implications for the revision of existing interest scales as well as for the development of new ones.

OBJECTIVES

OBJECTIVES

In view of the need for information on the scaling properties of interests, this study was initiated with three basic tasks in mind. These tasks were to:

A. Examine the implicit assumptions underlying various techniques of combining heterogeneous interest items into a "homogeneous" scale.

B. Apply scaling techniques heretofore unused in the interest field to the development of selected scales of educational-vocational interests.

C. Explore, within the context of relatively homogeneous groups of items, problems involved in the scaling of educational-vocational interests. Recent developments in data processing utilizing highspeed computers make such an exploration feasible.

The study tasks are expressed more explicitly in the following questions:

A. Will the equisection procedures used in developing the experimental scales yield reliable and stable results?

   (1) Is the factor structure of the scales stable over a period of time (test-retest)?

   (2) Is the factor structure similar for two independent samples (cross-validation)?

B. Is the factor structure obtained from scales developed by an equisection technique similar to the factor structure obtained from scales developed by a paired comparison technique?

C. Does the factor structure of the scales within one item category, such as hobbies, differ from the factor structure of the scales within another item category, such as job titles?

D. In the event that the answer to question C. is affirmative, what are feasible ways of utilizing information from such disparate areas?

RELATED RESEARCH

RELATED RESEARCH

Much of the relevant literature will be cited as appropriate throughout this report and, therefore, will not be mentioned in this section. This review will be restricted to studies relevant to nature of interests and to some general issues in scale construction.

Nature of Interests

There is a large body of literature dealing with the nature of interests and with the role of interests in decisions concerning educational and vocational choices. In a recent review of the research literature dealing with interest measurement, Super and Crites (1962) cite two books (Strong, 1943; Darley and Hagenah, 1955); ten monographs (Garrison, 1930; Strong, 1931; Super, 1940; Darley, 1941; Carter, 1944; Barnette, et al., 1952; Guilford, et al., 1954; Strong, 1955; and Layton, 1960); and a number of reviews of research published in journals (Berdie, 1944; Super, 1945, 1947, 1954).

Much of the literature cited in the above publications is only indirectly relevant to the purposes of this study. Therefore, it will not be dealt with further in this section. This review will be limited to factor analytic studies of the interest domain. It was from the results of these factor analytic studies that the dimensions of the experimental instrument used in this project were evolved.

One of the earliest studies of interest factors was conducted by Thurstone (1931). Using data supplied by E. K. Strong, Jr., he analyzed 18 interest scales by the multiple factor method. Four factors were extracted: interest in science; interest in language; interest in people; and interest in business. Thurstone suggested that special scoring keys might be developed to measure these factors.

Somewhat later, Strong (1943) summarized the results of six additional factor analytic studies of vocational interests. The number of scales included in each study varied from 25 to 36. He concluded that all the studies tended to establish the fact that four or five factors would account for nearly all the variations in interest among the occupational groups studied to 1943. He noted that this conclusion was true for both high school boys and college senior men.

Strong named three of the five factors "Science", "Things vs. People", and "Working with People for their Presumed Good". He tentatively called another factor "CPA"; factor five remained unnamed because it contained only three significant loadings and the loadings suggested no suitable title for the factor.

These early studies have been influential on the field of interest measurement from the standpoint of interpreting interest scores. The groupings of scales and the pattern analysis of scores have followed along lines suggested by these studies. Surprisingly enough, however, the studies have had little effect on scale development. Although these early studies had some influence on the content of the experimental instrument used in this project, the instrument was based primarily on two studies reported since 1950.

Cottle (1950) factor analyzed the Minnesota Multiphasic Personality Inventory, short form; the scores for groups I, II, V, VIII, IX, X, and the three non-occupational keys of the SVIB; the KPR, including a masculinity-femininity scale; and the Bell Adjustment Inventory. His subjects were 400 male veterans of World War II. The factors were extracted by means of Thurstone's single plane method.

Five bipolar factors which were considered to be within the interest domain were extracted. Cottle's factors have been named by the U. S. Employment Services (undated) as follows:

1.	Situations involving a preference for activities dealing with things and objects.	vs.	Situations involving a preference for activities concerned with people and the communication of ideas.
2.	Situations involving a preference for activities involving business contact with people.	vs.	Situations involving a preference for activities of a scientific and technical nature.
3.	Situations involving a preference for activities of a routine, concrete, organized nature.	vs.	Situations involving a preference for activities of an abstract and creative nature.
4.	Situations involving a preference for working for people for their presumed good as in the social welfare sense, or for dealing with people and language in social situations.	vs.	Situations involving a preference for activities that are non-social in nature and are carried on in relation to processes, machines and techniques.
5.	Situations involving a preference for activities resulting in prestige or the esteem of others.	vs.	Situations involving a preference for activities resulting in tangible, productive satisfaction.

The second study of particular relevance to the project described in this report was carried out by Guilford and his associates (1954). They hypothesized the existence of 33 factors and constructed a short test for each hypothesized factor. These tests were administered to 800 airmen and 800 airforce officers. Twenty-four factors were isolated for airmen; 23 for the officers. Only eight of these factors are in what is commonly considered to be the interest domain. The others are usually classified as personality or temperament variables. Of the eight interest factors only two, aesthetic appreciation and aesthetic expression, are different from those reported in other studies.

After examining the various studies dealing with interest factors, Super and Crites (1962, p. 383-384) suggest that the following factors are fairly well established:

Scientific -- an interest in knowing the "how" and "why" of things;

Social Welfare -- interest in people for their own sake;

Literary -- interest in use of words and in the manipulation of verbal concepts;

Material -- interest in working with tangibles;

Systematic -- interest in recordkeeping;

Contact -- interest in dealing with people for material gain;

Aesthetic -- expression and appreciation, regardless of subject matter.

The factors finally selected as dimensions around which to build scales were the five bipolar factors reported by Cottle, and Guilford's two aesthetic factors. A number of Cottle's factors were modified somewhat by the writers and were renamed. A discussion of these modifications appears in the procedure section. The interest factors selected as a basis for instrument construction probably do not exhaust the possible factors included in the interest domain. They are, however, fairly representative of the factors which have been reported to date. For purposes of the present study, the two major concerns were: (1) that a reasonable number of factors be selected around which scales could be developed; and (2) that the factors clearly lie within what is usually recognized as the interest domain.

Issues in Scale Construction

A number of issues pertaining to the development of scales, particularly those designed to measure non-cognitive attributes, have been debated over the past three decades. Some of these issues, which are relevant to decisions concerning the format of the experimental instrument used in this study, will be discussed in the following section.

Homogeneous vs. Heterogeneous Scales

Two decidedly different strategies have been employed in the construction of measures of non-cognitive aspects of human behavior. An empirical approach, illustrated by the SVIB, is the selection of items which differentiate designated criterion groups. As has been indicated already, apparently little concern is given to the content of items which go into the specific scales. Items are assigned weights relative to the degree to which the items differentiate among criterion samples. The only real concern is the predictive or concurrent validity of the scale. Strong has not evidenced much concern about the psychological variables being measured by his scales. As a result, his scales are heterogeneous in item content.

A second strategy of scale construction is the selection of items which presumably are on some psychological continuum underlying the scale being constructed. By internal consistency analysis or other procedures, items are retained which contribute to the total score for the scale. For example, the Science scale of the KPR contains items which have face validity and which correlate highly with the total score on the scale. Item content is a major consideration with this second strategy and the resulting scales are relatively more homogeneous than those developed empirically by Strong with the SVIB. Even so, a given scale may be quite heterogeneous in that items covering a wide range of categories, e.g., leisure time activities, reading interests, and job interests, are used with a common referent, such as science or music.

In general, heterogeneous scales tend to be better predictors of complex criteria than do homogeneous scales. For example, omnibus intelligence scales, such as the Otis Self-Administering Tests of Mental Ability (1928) have been better predictors of grades than have the so-called factor pure scales of instruments, such as the Primary Mental Abilities Test (1947). Apparently, by including heterogeneous items, the test stands a better opportunity to relate to some aspect of the criterion.

The predictive advantage of heterogeneous items also holds for interest scales. Gee and Clark (1956) demonstrated that heterogeneous scales are decidedly more effective than homogeneous scales in differentiating occupational criterion groups of Navy enlisted men.

Thus, in developing the Minnesota Vocational Interest Inventory (MVII), Clark (1946) deliberately sought to maximize heterogeneity of his scales by selecting items having high correlations with an external criterion and having low correlations with clusters of the other items included in a particular scale. The relatively high validities of the scales of the SVIB for differentiating among the various professions are probably due, in part, to the high degree of item heterogeneity.

It could be argued for a number of reasons that homogeneous scales, such as those on the KPR, are potentially more useful than are the empirical type keys of the SVIB. Consider simply the problem of economy of measurement. An endless number of scales could be developed for the Strong Blank to differentiate among various groups of people. When does one reach the point of diminishing returns--where new scales add little new knowledge of the interest domain? On the other hand, one can construct, theoretically, a limited number of relatively homogeneous scales which will tap the various dimensions of the interest domain. A second advantage of homogeneous scales is the relative ease of interpretation. Having some knowledge of the underlying psychological continua, it is easier to extrapolate from known validity data than is the case with highly complex heterogeneous scales. Also, from a theoretical standpoint, the fact that knowledge of the psychological continua underlying factorially pure scales could be readily determined would facilitate theory building within the interest field.

It is possible that the predictive superiority of heterogeneous scales over homogeneous scales may be accounted for largely by the fact that knowledge of how to use profile type information from a series of homogeneous scales has not been readily available. Multivariate analytical techniques, such as canonical correlations, although developed in the 1930's and 1940's, have not been widely used because of complicated and laborious computational procedures. However, with the development of computers, and as computer programs are written, complex computational procedures pose no problem.

In the discussion of the relative merits of homogeneous versus heterogeneous scales, one should keep in mind that the distinction between the two types of scales is a matter of degree of item homogeneity. The items on a Kuder scale, while all related to a broad area, such as science, represent a rather wide range of activities and attributes. Apparently, it is assumed that as long as the items are concerned with preference and are within a particular field or a broad area, it is proper to combine the items. Insofar as the present writers have been able to determine, no one has examined this assumption to determine whether items representing diverse activities have similar factor structures. As indicated earlier, one of the basic purposes of this study is to examine this assumption. This examination is made possible by the development of a series of homogeneous scales. While the items within a scale are homogeneous, the scales represent different activities within the interest domain.

Forced Choice vs. "Free" Response

A number of advantages have been attributed to the forced choice type of item over so-called "free response" items; i.e., items to which a person may indicate all "like" or all "dislike", if he so chooses. Cronbach (1950) has argued that the forced choice response will reduce the effects of response set and of social desirability--factors which are particularly troublesome in some self-report measures. Gordon (1941) suggested that the forced choice response will reduce rater bias and will yield more low scores for the criterion groups; i.e., scores will tend to be spread out to more nearly approximate the possible range of scores.

Reduction of factors such as response set or cognitive style may be a mixed blessing in the measurement of interests. As Clark (1961) has pointed out, there are marked group differences in the tendency to mark "like" and "dislike" responses. Stewart (1960) has shown that these response tendencies are correlated with other personality measures. In empirically derived scales, systematic biases of the above types are as useful as any other type of systematic response tendency which stereotype membership in any interest criterion group. In fact, these response biases may provide the significant basis for distinguishing among special groups of people. Clark (1961) argued, however, that systematic response biases should probably be eliminated from factorially pure scales unless the bias defines a dimension related to the classification.

The effect of "set" on responses obtained by the equisection procedures are unknown. Because of the need for "free" response in the scaling aspects of the present study, the writers were willing to accept the risk that response biases would increase the difficulty of developing homogeneous scales. The degree to which response set enters the various scales or into the item areas themselves, e.g., courses of study, characteristics of people, reading interests, etc., will be investigated at a future date.

There is some evidence that scales with forced choice type items tend to be better predictors and to discriminate more effectively among criterion groups than other types of psychological scales. Gordon (1951) found the forced choice to be more efficient than the usual questionnaire procedure in the assessment of selected personality traits, such as ascendency and responsibility. More recently, Newman, et al. (1957) found a forced rating procedure to be superior to ratings on a five point scale for evaluating professional health personnel.

The superiority of the forced choice method appears to apply as well to the interest domain. Perry (1955) has shown that the forced choice format was more effective than the "like", "indifferent", "dislike" type of response, as used on the SVIB, in differentiating college students from Navy yeomen. Seven of 10 comparisons favored the forced choice items. Perry emphasized, however, that the observed differences between the two types of items were rather small.

Despite the rather convincing evidence concerning the superior validities of the forced choice format, the technique has elicited sharp criticism. Travers (1951) argued that this type of item often requires the subject to make illogical responses, particularly in personnel ratings. It would seem that the criticism would be equally valid for measures of interest. For example, with the triad item format in the KPR, a subject is forced to choose one item which he likes most and one which he likes least. Presumably, the third alternative lies somewhere between these two items in terms of his preference. If the subject does not particularly like any of the choices available to him are his responses meaningful? Of course, it has been argued that the subject is merely indicating a preference among items. But it is not logical to give the same weight in the total scores to a choice between two items when the subject greatly prefers one to the other as to a choice between two items for which the subject's preferences are about equal.

Even though the forced choice response has certain advantages, it was rejected for this study for two reasons: First, the writers are opposed to the practice of forcing a subject to make illogical choices, particularly within the interest domain. Second, the subject's freedom to respond to each item as he wishes was an important consideration underlying the scaling aspects of this study. Any type of item requiring the subject to order or rank alternatives available to him was rejected for the same reasons.

It should be pointed out that the equisection procedure used with our experimental instrument requires the subject to make a series of three forced choice decisions. For example, he has to decide whether a stimulus item falls in the upper or lower half of a continuum, then in which quarter, and finally to which anchor point the stimulus is nearer. But in the final analysis, he can place his response anywhere he chooses within the limits of a ten-point scale.

Unit or Differential Weights

Considerable disagreement exists as to the best method of weighting items on interest scales. Strong has argued that differential weights are to be preferred to unit weights. He found that while scales using unit weights tend to be slightly more reliable, they are less valid than those scales scored by differential weights. Unit weights resulted in appreciably greater overlap among his occupational criterion groups. However, evidence reported by Kuder (1957) and, more recently, by Clark (1961) indicates that unit weights are as good as, if not superior to, differential weights in terms of degree of scale overlap.

For this study the assignment of weights to items posed no problem. As will be described in a later section, the equisection scaling procedure determines an individual's score for each item and, consequently, provides the appropriate weight for the item.

Challenge to the Subject

The writers are not aware of any research on the degree of challenge afforded to subjects by currently available interest inventories. KPR items tend to be repetitive and observation would indicate that many subjects become bored before the completion of the 400 items of the SVIB. Thus, a consideration in devising measures to be used in this study was to select items which would be interesting and challenging to the subjects, i.e., items which he could not answer without a considerable investment of himself in the task at hand.

PROCEDURE

PROCEDURE

Rationale for Equisection Procedure

This study introduces a new approach to interest assessment. As indicated in the introduction, it is patterned after an equisection scale for measuring social relations in small groups. The original scale, developed by Gardner and Thompson (1956), was referred to as a fractionation scale. In view of a more recent discussion by Torgerson (1958), it appears that the scale could be called more properly an equisection scale. Hereafter, in this report, we shall refer to both the Gardner and Thompson scale and the scale developed for this study as equisection scales.

The Gardner and Thompson scales obtain a subject's rating of the potential of other members of his group to satisfy his needs. The ratings are made along a broad and well-specified continuum in such a manner as to yield an equal interval scale. The scales were found to be useful in predicting esprit de corps, morale, group effectiveness, and leadership among various university groups.

From the success of Gardner and Thompson in applying the equisection technique to one non-cognitive area, sociometry, it would seem that the method may offer promise for use in other non-cognitive domains. A wider choice of statistical analyses can be applied to interval scales than appropriately may be applied to existing interest scales.

In presenting the rationale for their choice of scaling procedure, Gardner and Thompson defined a number of attributes of an ideal sociometric instrument--attributes which they believe to be satisfied by the equisection technique (Chapter V). A number of definitions which are applicable to this study have been rephrased so as to be appropriate to the interest domain and are listed below:

1. The frame of reference to which a subject responds should be related clearly to some aspect of the interest domain. The situation should be so defined that each subject will respond to it from the same frame of reference. Furthermore, the subject should be required to reveal, within the specified limits, his particular reference continuum.

   There can be no guarantee that all subjects will respond to any situation from a particular reference point, but the reference point can be delimited to a considerable degree. In this study, this was accomplished by means of a descriptive paragraph and also by instructing the subject to attempt to ignore certain factors, such as prestige and income.

2. The continuum to which the subject is asked to respond should be firmly anchored at the extremes and at a number of intervening points. The anchors should be obtained from a population which is larger than the sub-population being studied. An example of a larger population might be all possible characteristics of jobs of which one has knowledge. This

larger population should encompass the respondent's interests with respect to his preferences for certain job characteristics. The continuum should be divided into as many non-overlapping segments as can be judged reliably.

3. The judgmental process should require each subject to select from the specified population those aspects of the interest domain which represent for him the end-points of the reference continuum. Gardner and Thompson argue that this procedure insures a psychologically common origin and extreme end-points for all individuals within and across groups (p. 23). A further requirement is that the subject bisect the reference continuum at several points with choices from the larger population--(the population being depicted as normally distributed)--in order to obtain an interval scale. After the continuum has been anchored, the subject should be required to relate several stimulus items by a series of successively restricted dyadic choices to the reference continuum.

4. The psychological properties of equisection scales are two-fold. For each item in the scale there should be a distribution of scores representing the value of the item to the group. Also, there should be a distribution of scores for each individual on items representing different factors within a particular interest domain.

(The term "factor" is used in the same sense as factor obtained from factor analyses.) In the present study, the primary focus is on the second property, the distribution of scores for each individual.

5. The experimental scale should yield interval scales which are reliable, valid for scaling a well-defined variable, and practical in terms of economy of time. Gardner and Thompson (p. 27) claim that the equisection technique provides reasonable approximations of interval scales. This assumption, as well as the reliability and some aspects of the validity of the scales, are problems to be investigated in this study.

   No claim can be made that the experimental instrument used in this study is more practical than existing interest measurement inventories in terms of characteristics, such as ease of administration and economy of time. As a matter of fact, the anchoring process on the experimental instrument proved to be a difficult task for a large percentage of the subjects. It requires searching thought and personal challenge. As discussed elsewhere, herein lies much of the instrument's appeal to subjects.

Test Construction

As indicated in the review of previous research, a number of studies have reported similar "factors" relating to interests. The most clearcut representation of these factors appears to be found in the work of Cottle (1950). Therefore, Cottle's factors, as named by the U. S. Employment Services(undated), were used as a basis for the initial phases of constructing the experimental instrument used in this study. The factors were modified in a manner described later in this section.

The writers attempted to construct, on an a priori basis, interest items within a particular area, such as all possible hobbies, which would represent the presumed "essence" of each pole of Cottle's five bipolar factors. Finding hobbies which correspond to a number of the interest factors proved to be impossible. Hobbies are not sufficiently stereotyped to fit neatly into all the interest factors. The same difficulty became apparent in other item categories, such as jobs. However, by shifting the emphasis to attributes of jobs or hobbies in general, it was relatively easy to devise the items for each of the factors. Following this procedure, the writers developed a series of test items within a number of interest categories, each item reflecting the factor structure suggested by Cottle.

At this point, a two-day conference was held with a number of individuals who are knowledgeable within the field of interest measurement. During the conference it became clear that the Cottle factors omitted consideration of interest in either aesthetic expression or [illegible](?) aesthetic appreciation. Thus, these two factors were added. Definition of these two factors was based on the work of Guilford, et al. (1954).

Additional deviations from Cottle's factor structure developed from the conference. The U. S. Employment Services has defined the positive pole of Cottle's factor five as "situations involving a preference for activities resulting in prestige or the esteem of others". Persons with high scores on this factor could be of two distinct types. One type has prestige and esteem because of the position he holds; the other type seeks esteem by associating with persons who have high prestige. Both factors were included in the scale; although, there was a strong possibility that they might collapse into one factor. Further changes were suggested in the USES terminology relative to factor one, "things versus people"; factor four, "social welfare versus process"; and factor five, "prestige versus tangible products". These changes will be indicated in the description of the revised scales.

Examination of the actual factor plots of each of the bipolar factors described by Cottle resulted in a number of modifications of the factor structure he had suggested. The major modification grew out of the realization that the factor plots did not yield completely convincing evidence of the bipolarity of the five factors. As a consequence, the decision was made to modify each bipolar factor where necessary in order that they might be treated as ten separate factors.

Cottle named his factors by choosing tests which had high loadings on a given normal to a hyper-plane; however, some of these tests also had high positive or negative loadings on other normals. For example, science had high positive loadings on Cottle's factor one and low loadings on factors two and three. Business detail had high positive loadings on both factors two and three. By eliminating business detail and science from consideration, interpretation of the factors and writing items for them became much simpler. Now, items in the science category could be written for all factors. Detail and order are involved in scientific activities, as well as aesthetic appreciation, adventure, and so on.

The final experimental instrument then was constructed to measure preference for activities across 12 factors. Nine of these are either taken directly from, or are modifications of, those proposed by Cottle; two are from Guilford; and one grew out of the conference deliberations. The following is a description of the 12 factors, partly a priori and partly empirical, around which the experimental instrument used on this study was written.

Factor I. Adventurous. This factor, a modification of Cottle's "Things vs. People", represents a preference for activities of a highly masculine type. In terms of scales on the SVIB and the KPR, this factor represents a high masculinity-femininity score, accompanied by negligible emphasis on aesthetic, cultural, and scientific activities. Typical items written for this factor include: Commando-training for hand-to-hand fighting and survival; Taming the wilderness; Perform as a stuntman; Opportunity for excitement and adventure.

Factor II. Linguistic-manipulative, for one's own ends. This factor, usually referred to as business contact, represents preference for activities involving linguistic control over other individuals to accomplish one's own goals. From Cottle's study, business contact and business detail from the SVIB and persuasive from the KPR would load high on this factor. However, the writers attempted to remove the business aspect from this factor and to emphasize control of others by verbal means. This change made possible a a clearer distinction between this factor and Factor V (below). Representative items include: Opportunity to influence people or manage others; Urge friends to join you in some activity.

Factor III. Detail, order. This factor represents preference for activities of a clerical nature, but more broadly, preference for methodical treatment of many aspects of life. From Cottle's study, this factor is high on business detail, clerical and computational. However, we attempted to modify the "business" aspect of this factor to provide more generality and, at the same time, to remove the business concept shared by so many other factors. Thus, the emphasis is on detail and order, regardless of the area within which the activity occurs. Items written include: Opportunity to work in an orderly and systematic manner; Accounting; Arrange a stamp collection; Plan a production schedule.

Factor IV. Nurturance. This factor is virtually unchanged from Cottle. It represents high interest maturity and social welfare (SVIB). The task here was to write items which dealt with concern for the welfare of others and desire to help the less fortunate. Typical items include: Opportunity to help others; Social welfare; Work with a group of youngsters at the Boys' Club; Sympathetic people.

Factor V. Overt, impersonal control as a result of position. This factor represents preference for situations involving control over others as a result of one's own position (status). From Cottle's study, interest maturity (SVIB) loads well on this factor. An attempt was made to eliminate the linguistic-persuasive aspects of control represented by Factor II. Representative items include: Opportunity to be in responsible and important position; Serve as chairman of a board; Leaders; Military policeman.

Factor VI. Esteem (status) seeking. This factor was developed in an attempt to differentiate from Factor V a kind of status which accrues to an individual as a result of his association with a person or persons who have status, perhaps, in the sense described in Factor V. Nothing in Cottle's study resembles this factor. Items written to measure the factor include: Opportunity to associate with important or key people; To get to know the leaders of the country; Famous people; Accompany stars on city tours.

Factor VII. Linguistic expression. This factor represents preference for literary expression. From Cottle's study, linguistic (SVIB) and literary (KPR) load heavily on this factor. An attempt was made to distinguish linguistic expression from artistic expression; the latter aspect was included in Factor XI. Consequently, each item for this factor has within it some aspect of linguistic communication as the following items show: Opportunity to write -- to express my thoughts; Creative writing; Fluent, articulate people--people who can use words.

Factor VIII. *Concrete, non-operative means*. This factor represents preference for activities which have a definite goal, but which do *not* involve specific operations of particular kinds of equipment. This latter aspect was reserved for Factor X below. The conception of this factor was representation of the kind of person whose interests are basically goal oriented, i.e., getting the task completed, with equipment operation secondary to completion of the task. It differs from Cottle's factor in that it is more goal oriented. Examples of items include: Opportunity to devise and carry out concrete methods or procedures for attaining some goal; Directs research and development; Design and build a hi-fi unit.

Factor IX. *Abstract thinking, ideas*. This factor represents preference for activities dealing with ideas. An attempt was made to make this factor deal with a very generalized type of abstractness of ideas, avoiding both linguistic expression (Factor VII) and aesthetic expression (Factor XI). Illustrative items include: Opportunity to think--to work with ideas; Books on theoretical and abstract topics.

Factor X. Concrete-operative means. This factor represents preference for activities which require performance (operation) directed toward a specific goal which results in a tangible, productive satisfaction. This factor combines the negative poles of Cottle's factors four and five because the writers found it impossible to differentiate the two on the basis of his factor plots. The emphasis of this factor is on accomplishing some task, usually by a specific means, such as use of a machine or process. Items from this factor include: Opportunity to work with equipment; Supervise production; Genius at running equipment; Motor operator--operates military vehicles.

Factor XI. Aesthetic expression. This factor from Guilford (1954) represents preference for activities requiring creative expression through such media as music, architecture, sculpture, etc. Again, the attempt was made to write items which differentiate this factor from linguistic expression (Factor VII); dealing with ideas, abstractions (Factor IX); and art appreciation (Factor XII). Emphasis was based particularly on some type of artistic production as is illustrated by the following items: Design special costumes; Musician--play an instrument in the post band; Supervise architectural and plant design.

Factor XII. Aesthetic appreciation. This factor represents preference for activities dealing with appreciation, as opposed to creation, of objects around the individual. This factor, also from Guilford, is considerably more passive in its orientation than are the previous factors. Items include: Collect native works of art; Listen to a new record album; Cultured people.

Test Format

The final form of the experimental instrument is shown in Appendix B. The test items were written to conform to the 12 factors described in the previous section. It was fully expected that a number of the factors would collapse when an item analysis was performed.

Items were written around certain interest areas such as, reading or college curricula. For a given area, one item was written for each factor, or a total of 12 items for each area. There were 11 areas or item categories included in the test, making a total of 132 items altogether. For the final form of the experimental instrument, the items were arranged in random order within each item category.

As described earlier in this report, the items were cast in a form adapted from the equisection procedure employed by Gardner and Thompson (1956) in developing their Social Relations Scales. The task presented to the subject may be illustrated by describing the procedure for the first item area.

After initial instructions, the subject is confronted with the following material: (See Figure 1.)

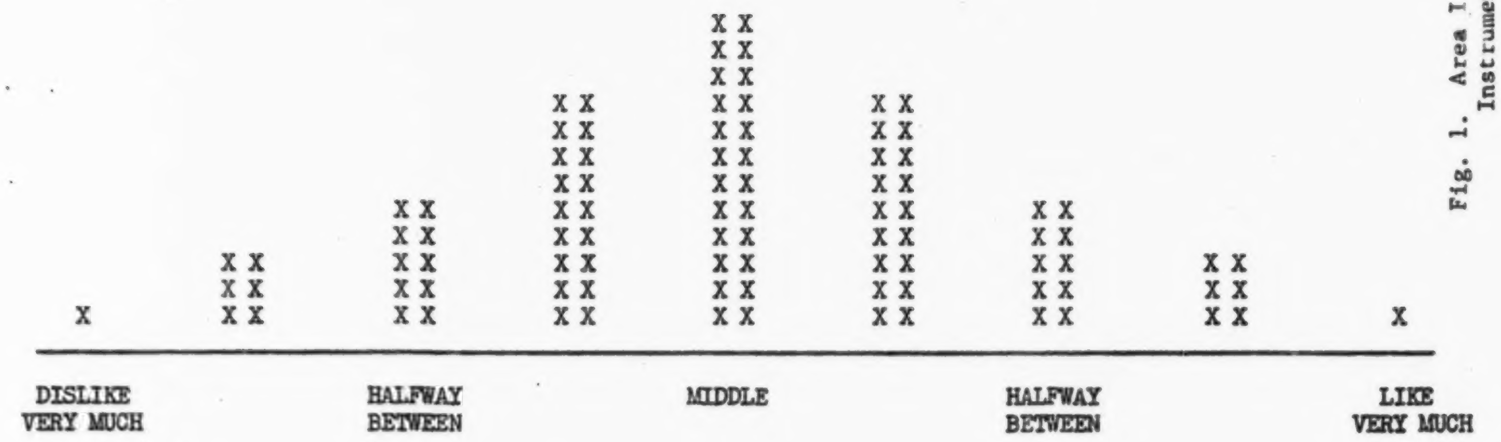
The subject is instructed to provide anchors for the various item categories in the following manner. First, from all possible responses relevant to the stimulus paragraph, he is asked to write in the box labeled, "Like Very Much", one response in which he would find a great deal of satisfaction. This is followed by requiring the subject to choose from his available responses one which he would "dislike very much" and to enter this in the box at the extreme left. This procedure provides the anchors at the ends of a continuum of interest within a particular interest area.

Following the anchoring of the extremes, the subject is then required to bisect the continuum and write in the box labeled, "Middle", a response which is halfway between the extremes. Note here also that the "Middle" category need not represent a "zero" or "no interest" category. The next task is to bisect the left half of the continuum, that is, to write in the box labeled, "Halfway Between", a response which is about halfway between "Dislike Very Much" and "Middle". The same procedure is then used to fill in the remaining "Halfway Between" box with an answer that falls halfway between "Middle" and "Like Very Much". The subject supplies these responses before he sees the test items.

Following the anchoring procedure, the second task of the subject is to respond to the test items proper in the context of his "anchors". Thus, he turns back the sheet with the pictograph, exposing

DO NOT TURN COVER SHEET UNTIL YOU

HAVE FILLED IN THE BOXES


DISLIKE VERY MUCH
HALFWAY BETWEEN
MIDDLE
HALFWAY BETWEEN
LIKE VERY MUCH

COVER SHEET

Fig. 1. Area I of Experimental
Instrument Form II

AREA I   Think of the X's in the picture as showing all possible characteristics of jobs which people might find pleasant or unpleasant. An example of such a characteristic might be "pleasant co-workers". Do not consider salary or level of training which might be implied, and do not use job titles.

ITEMS	Less than Dislike Very Much	DISLIKE VERY MUCH	HALFWAY BETWEEN	MIDDLE	HALFWAY BETWEEN	LIKE VERY MUCH	Better than Like Very Much
1. Opportunity to write-to express my thoughts	——	——/——	——/——	——/——	——/——	——	
2. Opportunity to work with equipment	——	——/——	——/——	——/——	——/——	——	
3. Opportunity to influence people or manage others	——	——/——	——/——	——/——	——/——	——	
4. Opportunity to enjoy the beauty around me	——	——/——	——/——	——/——	——/——	——	
5. To associate with important or key people	——	——/——	——/——	——/——	——/——	——	
6. Opportunity to devise concrete methods for attaining some goal	——	——/——	——/——	——/——	——/——	——	
7. Opportunity for excitement and adventure	——	——/——	——/——	——/——	——/——	——	
8. Opportunity to use my artistic ability	——	——/——	——/——	——/——	——/——	——	
9. Opportunity to think-to work with ideas	——	——/——	——/——	——/——	——/——	——	
10. Opportunity to help others	——	——/——	——/——	——/——	——/——	——	
11. Opportunity to be in responsible position-a leader	——	——/——	——/——	——/——	——/——	——	
12. Opportunity to work in orderly, systematic manner	——	——/——	——/——	——/——	——/——	——	

the 12 items which belong with the stimulus paragraph. The subject is instructed to compare each item, e.g., "Opportunity to write--to express my thoughts", with his expressed preference in the boxes. He is required to make three decisions: to decide whether the item falls in the upper or lower half of the continuum of his preference; to decide in which quarter of the continuum the item belongs; and, finally, to place an "X" on a line showing to which of his reference points the particular item is closer. In order to provide for situations where a subject's reaction to an item might be more extreme than one of his two extreme anchor points, an extra space was provided at each end of the continuum. Responses in these spaces were relatively rare. This procedure resulted in a 10-unit interval scale ranging from "Less Than Dislike Very Much" to "More Than Like Very Much". After responding to the 12 items in a given item area, the subject anchors another area and proceeds as before.

Scoring the Items

Each item was scored on a scale of from one to ten, depending on where the subject placed his response. A score of zero was assigned to a response of "Less Than Dislike Very Much"; nine to a response of "More Than Like Very Much". If the subject indicated the item was identical, in terms of preference, to one of his anchors, the response was given the average of the two adjacent score points. If a subject omitted an item, it was scored in the following manner: first, the average for the area in which the blank occurred was computed; second, the scores for the factor in all other item categories were averaged;

then these two means were averaged to yield the missing score.

Samples

A number of samples were used in this study. Each will be described in turn.

Sample I. This sample was used in the examination of the similarity of factor structures underlying the interest areas and in the first study of the stability of the factor structures within two samples (cross-validation). This sample was composed of approximately 250 male, junior college students. All of the students were enrolled in freshmen orientation courses during the spring semester, 1962. The subjects were obtained from four junior colleges within the San Francisco Bay Area. All subjects in Sample I were volunteers.

If a subject omitted more than two items in the inventory, his scores were not considered in any subsequent analyses. Thus, 188 subjects remained in Sample I after those subjects who had made more than the allowable number of errors or omissions were removed.

Sample II. For purposes of assessing the test-retest reliability of the experimental instrument, a second sample of 182 subjects was obtained from a local junior college during the fall semester, 1962. The sample, including both males and females, was obtained from freshmen orientation classes. The experimental instrument was administered twice within a time interval of five weeks between the two administrations. The first test was administered to entire classes; whereas, the subjects volunteered for the second administration. Eighty-nine subjects completed the instrument both times with no more than two errors in either test. For the reliability check these 89 subjects comprised the sample. The 182 subjects who completed the first testing correctly were used for a second cross-validation study.

Sample III. This sample was composed of 397 men and women junior college students. With the exception of two classes of general psychology students, they were obtained from freshmen orientation classes. This sample was used for the paired comparison studies. Two hundred fifty-six of the subjects completed one interest category; 139, two categories; and 2, three categories.

For the purposes of the research described in this report, the investigators were not concerned that the samples be representative of any well-defined population. The scales were being used as non-normative measures and only intra-individual variations were of interest at this time.

Junior college students were used as subjects for two reasons: convenience and general academic ability. It was necessary that the investigators have access to a large number of students over a period of time. Thus, it was important to find groups where the data collection would not seriously disrupt ongoing class activities. The orientation classes provided an excellent opportunity to integrate the data collection activities with self-exploration units which were routinely included in the course. Completing the experimental instrument in its present form was not an easy task. The vocabulary used in the instrument required high level reading ability; consequently, subjects were sought who could be expected to be of somewhat better than average academic ability.

Collecting the Data

With Sample I, subjects reported on their own time to a pre-assigned room. They were also invited to complete the SVIB and the KPR at home.

With Sample II, the initial administration of the experimental instrument was made to entire classes. Then, after a five-week interval, those students who had not made errors on the first test were asked to re-take the test on their own time.

With Sample III, the paired comparisons were administered to the entire classes. If both the anchoring procedure and the paired comparisons were not completed in one class period, 50 minutes, students were asked to complete the instrument outside the class and return it to the instructor. A number of students volunteered to complete additional areas.

Scaling Procedure and Data Analyses

For all analyses the test scores were transferred to IBM cards. The specific procedures used in the various analyses will be described in the appropriate section along with the findings.

The equisection scaling procedures are described by Torgerson (1958). The rationale for use of an adaptation of the procedure as used by Gardner & Thompson (1956) and in this study has been discussed earlier in this section. The specific application of the technique has been discussed earlier in the description of the experimental instrument.

The paired comparison scaling procedures used in this study followed the conventional Thurstone Case V method (1927). The computational methods used in this study are those outlined in Torgerson.

For the cross-validation purposes, i.e., comparing half of the original sample with the second half of the sample, Wilks' procedure (1946) was used. The Wilks' test is a test of the equality of covariance matrices, a sufficient condition for equivalence of factor structure. The mathematical basis for the test is presented in Anderson (1958, Chapter 10).

The computational formulae used in this study were developed by Box (1949) and are as follows:

Given k sets of p variates:

$$M = N \log_e |S_{ij}| - \sum_{\ell=1}^{k} (\nu_\ell \log_e |S_{ij\ell}|) = - N \log_e L_\ell'$$

$$\text{where } L_\ell' = \prod_{\ell=1}^{k} \left\{\frac{|S_{ij\ell}|}{|S_{ij}|}\right\}^{\nu_\ell / N} \quad \text{and } df_\ell = \nu_\ell$$

When $k = 2$ and $df_1 = df_2$

$$M = - N \log_e \left\{ \frac{|S_{ij1}|^{\frac{1}{2}}}{|S_{ij}|^{\frac{1}{2}}} \cdot \frac{|S_{ij2}|^{\frac{1}{2}}}{|S_{ij}|^{\frac{1}{2}}} \right\}$$

where $|S_{ij1}|$ = determinant of covariance matrix of set 1

and $|S_{ij2}|$ = determinant of covariance matrix of set 2

then, $M = - (N - 2)[\tfrac{1}{2}(\log_e |S_{ij1}| + \log_e |S_{ij2}|) - \log_e |S_{ij}|]$

where $|S_{ij}|$ = determinant of sum matrix of the covariance matrices of sets 1 and 2 multiplied by $1/2^p$.

For the multivariate statistic, $p > 1$, M/C is considered to be distributed approximately as X^2 with $f = \frac{1}{2} (k - 1) p (p + 1)$ degrees of freedom. If the degrees of freedom are equal, then

$$\frac{1}{C} = 1 - \frac{(2p^2 + 3p - 1)(k + 1)}{6(p + 1)kv}$$

As one indication of whether the various item categories were parallel tests, Wilks' (1946) statistic, L_{mvc} for determining the equality of means, variances, and covariances, was used. Computational procedures for this statistic are outlined in Gulliksen (1950). A FORTRAN program for the Wilks' Criterion Test has been published by Madden, _et al_. (1959).[1]

---

[1] This program was adapted for IBM 7090 and extended for purposes of this study by Manford J. Ferris.

The following analyses were made by means of canonical correlation:

a. Computed test-retest reliability.
b. Compared experimental scores with paired comparison scaling.
c. Compared item categories on experimental scales.
d. Compared experimental scales with the SVIB and KPR.

Canonical correlation provides a means of determining the linear combinations of two sets of variates which yield a maximum correlation. Then, a second set of linear combinations are located, independent of the first linear combinations which yield a maximum correlation. This process is continued until correlation of additional linear combinations ceases to yield statistically significant information about the relationships between the two sets of variates. Although the theory of canonical correlations was developed by Hotelling in 1936, it has received very little use by psychologists. Undoubtedly, one of the major drawbacks to its use has been the rather laborious computational procedures. With the advent of highspeed computers and suitable programs, computational difficulties are no longer a hindrance to the use of the technique.

The mathematics of canonical correlation and computational procedures have been outlined by Anderson (1958). A modification of a FORTRAN program developed by Cooley and Lohnes (1962) was used in the analyses reported in this study.

A number of procedures have been proposed for determining the signigicance of canonical correlations. The two used in this study are a maximum likelihood test proposed by Bartlett (1941) and a second test proposed by Kullback (1959). These two tests will be discussed in the findings section of this report.

ANALYSES OF THE DATA AND THE FINDINGS

ANALYSES OF THE DATA AND THE FINDINGS

Stability of Factor Structure

The discussion of the data analyses and the findings has been organized around the research questions posed in the original grant application (see p. 3, Appendix A). So that the findings may be discussed in logical sequence, the order in which the questions are considered will vary somewhat from that in Appendix A.

Will the equisection procedures yield reliable and stable results?

The first aspect of this question to be examined was the stability of factor structure between two independent samples. Two analyses are relevant to this problem: the Wilks' test for equality of covariance for two samples and two sets of canonical correlations among item areas--one based on the original sample; the other on the reliability sample.

For the Wilks' test the original sample of 188 males was divided randomly into two groups of equal size. One group was considered to be a cross-validation sample. As indicated earlier, equality of covariance is a sufficient condition for equality of factor structure within the two samples.

The results are shown in Table 1. The analysis was made for each of the 11 interest item areas. A significant chi square indicates inequality of covariance.

All chi squares were non-significant except that for area eight. For this area chi square was significant beyond the .05 level. It was assumed, however, that this significance could be attributed to chance.

TABLE 1

WILKS' TEST FOR EQUALITY OF COVARIANCE MATRICES OF TWO RANDOMLY SELECTED SUBGROUPS OF ORIGINAL SUBJECTS

AREA	M/C[1]
1	78.30
2	87.63
3	86.17
4	73.79
5	92.35
6	79.46
7	90.38
8	108.08
9	96.87
10	95.02
11	81.30

---

[1] M/C has a χ^2 distribution with 78 degrees of freedom

$\chi^2_{\alpha=.05} = 99.61$

$\chi^2_{\alpha=.01} = 109.97$

Therefore, the factor structure underlying the 11 item areas was considered to be similar for the two subsamples which were then combined for all subsequent analyses.

Further evidence as to the stability of the factor structure from sample to sample can be obtained by comparing the canonical correlations among interest areas for the original sample and for the pretest of the reliability sample. These correlations are shown in Tables 5, 6, 7, 8, 9 and 10. The correlations for the original sample are above the diagonal; those for the reliability sample are below the diagonal. Only the first six correlations are reproduced for these tables. Complete sets of canonical correlations are shown in Appendix C. Note that the canonical correlations for the original and reliability samples were quite similar in magnitude. Again, this is further evidence that the factor structure underlying the item areas remained relatively constant from sample to sample. This is particularly important in view of the fact that the reliability sample included both men and women; the original sample, only males.

The second aspect of the question of stability of the factor structure of the items is the test-retest reliabilities over a period of five weeks. Canonical correlations were computed for the item areas and for the sum of the area scores on the a priori factors.[1] As indicated in the descriptions of the samples, 189 subjects took the pretest for the reliability analysis. Only 89 of these completed both pretest and retest without making more than two errors or omissions in recording their

---

[1] The rationale for summing the area scores is discussed under the heading: Factor Structure Underlying Item Areas.

TABLE 5

FIRST CANONICAL CORRELATION COEFFICIENT FOR ALL ITEM CATEGORIES[1,2]

AREA	1	2	3	4	5	6	7	8	9	10	11
1		.67	.68	.71	.63	.78	.74	.65	.66	.63	.68
2	.63		.60	.66	.60	.63	.63	.55	.48	.59	.55
3	.72	.68		.75	.66	.72	.77	.65	.62	.61	.70
4	.66	.63	.78		.67	.79	.80	.65	.66	.69	.74
5	.67	.58	.58	.64		.58	.65	.53	.54	.61	.62
6	.67	.60	.78	.76	.63		.83	.70	.69	.67	.64
7	.65	.58	.75	.67	.63	.72		.67	.69	.72	.72
8	.57	.56	.56	.62	.58	.62	.62		.67	.69	.66
9	.67	.62	.67	.70	.61	.72	.70	.66		.58	.70
10	.59	.59	.69	.68	.60	.69	.64	.63	.66		.62
11	.64	.58	.75	.70	.63	.76	.74	.67	.76	.69	

[1] Entries above the diagonal are based on the original sample (N=188).

[2] Entries below the diagonal are based on the pretest data for the reliability sample (N=182).

TABLE 6

SECOND CANONICAL CORRELATION COEFFICIENT FOR ALL ITEM CATEGORIES[1,2]

AREA	1	2	3	4	5	6	7	8	9	10	11
1		.59	.63	.60	.57	.65	.62	.54	.56	.60	.52
2	.54		.50	.49	.51	.49	.49	.51	.43	.57	.46
3	.56	.49		.61	.51	.55	.66	.57	.54	.58	.54
4	.60	.51	.66		.52	.70	.68	.58	.53	.64	.52
5	.56	.53	.56	.52		.55	.52	.48	.50	.57	.50
6	.63	.49	.63	.73	.60		.76	.63	.61	.56	.57
7	.57	.48	.64	.64	.45	.67		.64	.61	.61	.59
8	.53	.53	.54	.50	.55	.54	.60		.60	.53	.57
9	.56	.51	.58	.60	.53	.62	.57	.60		.56	.55
10	.53	.50	.54	.58	.51	.65	.54	.60	.59		.50
11	.52	.46	.58	.50	.51	.58	.66	.52	.56	.50	

[1] Entries above the diagonal are based on the original sample (N=188).

[2] Entries below the diagonal are based on the pretest data for the reliability sample (N=182).

TABLE 7

THIRD CANONICAL CORRELATION COEFFICIENT FOR ALL ITEM CATEGORIES[1,2]

AREA	1	2	3	4	5	6	7	8	9	10	11
1		.54	.49	.53	.47	.45	.49	.45	.50	.53	.50
2	.48		.44	.47	.45	.40	.46	.45	.40	.45	.40
3	.52	.43		.56	.46	.52	.55	.54	.49	.49	.46
4	.54	.46	.60		.47	.59	.56	.47	.52	.53	.48
5	.47	.48	.48	.48		.45	.46	.40	.39	.51	.44
6	.55	.48	.53	.61	.50		.60	.46	.55	.54	.48
7	.49	.42	.54	.52	.39	.56		.51	.44	.53	.53
8	.45	.43	.47	.50	.50	.48	.49		.56	.51	.50
9	.47	.41	.46	.53	.47	.58	.48	.50		.53	.51
10	.47	.41	.46	.52	.44	.46	.43	.45	.48		.42
11	.45	.46	.45	.45	.47	.51	.49	.48	.51	.44	

[1] Entries above the diagonal are based on the original sample (N=188).

[2] Entries below the diagonal are based on the pretest data for the reliability sample (N=182).

TABLE 8

FOURTH CANONICAL CORRELATION COEFFICIENT FOR ALL ITEM CATEGORIES[1,2]

AREA	1	2	3	4	5	6	7	8	9	10	11
1		.40	.41	.45	.41	.35	.46	.41	.41	.38	.39
2	.42		.39	.38	.41	.38	.37	.41	.34	.40	.33
3	.48	.36		.50	.40	.47	.46	.42	.43	.38	.41
4	.51	.41	.52		.36	.55	.55	.40	.39	.44	.45
5	.42	.43	.41	.43		.42	.40	.38	.37	.38	.43
6	.45	.40	.46	.50	.42		.52	.44	.36	.38	.36
7	.47	.34	.47	.48	.35	.48		.43	.43	.38	.48
8	.40	.36	.43	.46	.43	.45	.40		.44	.42	.44
9	.41	.40	.43	.46	.38	.49	.45	.36		.39	.44
10	.45	.37	.43	.41	.39	.42	.38	.42	.40		.39
11	.40	.36	.41	.43	.41	.47	.47	.44	.44	.34	

[1] Entries above the diagonal are based on the original sample (N=188).

[2] Entries below the diagonal are based on the pretest data for the reliability sample (N-182).

TABLE 9

FIFTH CANONICAL CORRELATION COEFFICIENT FOR ALL ITEM CATEGORIES[1,2]

AREA	1	2	3	4	5	6	7	8	9	10	11
1		.37	.35	.40	.37	.31	.39	.36	.37	.35	.36
2	.34		.36	.35	.35	.34	.32	.35	.28	.33	.31
3	.43	.35		.40	.37	.41	.40	.36	.29	.35	.35
4	.44	.36	.42		.33	.45	.43	.34	.32	.32	.33
5	.36	.30	.33	.37		.33	.34	.29	.35	.33	.36
6	.39	.35	.40	.47	.37		.39	.36	.32	.30	.33
7	.34	.31	.44	.41	.32	.37		.40	.39	.35	.40
8	.37	.32	.38	.43	.32	.39	.33		.36	.30	.37
9	.36	.34	.38	.34	.36	.36	.37	.30		.31	.32
10	.40	.31	.37	.34	.33	.39	.34	.33	.34		.37
11	.35	.33	.33	.31	.35	.28	.43	.35	.40	.30	

[1] Entries above the diagonal are based on the original sample (N=188).

[2] Entries below the diagonal are based on the pretest data for the reliability sample (N=182).

TABLE 10

SIXTH CANONICAL CORRELATION COEFFICIENT FOR ALL ITEM CATEGORIES[1,2]

AREA	1	2	3	4	5	6	7	8	9	10	11
1		.34	.30	.27	.34	.26	.36	.32	.28	.34	.31
2	.30		.35	.29	.32	.30	.29	.25	.27	.28	.26
3	.31	.28		.36	.29	.36	.32	.34	.27	.25	.29
4	.33	.30	.38		.29	.40	.36	.21	.28	.29	.32
5	.32	.27	.31	.32		.29	.24	.28	.25	.33	.31
6	.28	.25	.38	.38	.29		.35	.35	.26	.25	.29
7	.30	.27	.34	.35	.31	.35		.31	.30	.30	.38
8	.33	.25	.29	.30	.28	.35	.30		.32	.28	.26
9	.24	.29	.27	.32	.30	.33	.32	.28		.29	.28
10	.30	.27	.23	.30	.29	.28	.28	.29	.30		.29
11	.31	.28	.31	.28	.32	.26	.33	.30	.38	.26	

[1] Entries above the diagonal are based on the original sample (N=188).

[2] Entries below the diagonal are based on the pretest data for the reliability sample (N=182).

responses. Tests from these 89 subjects were used in this analysis. The results are shown in Table 2.

The first canonical correlations for the 11 item categories or areas ranged mostly in the high 80's; only two fell below .85. For total scores, i.e., when the items within an a priori interest factor were summed, the first canonical correlation was .945.

Because of the limited use which has been made of the technique of canonical correlation, measurement literature provides few reference points from which to interpret a given correlation. Thus, it may be well at this point to examine some correlations in terms of shifts in factor structure which might be anticipated with correlations of various magnitudes.

By multiplying the two input correlation matrices (predictor variables, R_{11}, and criterion variables, R_{22}) by the transpose of their respective weights, it is possible to obtain loadings which can be interpreted in the same way as loadings from factor analysis. When these loadings are plotted, one can observe the relative shift of variates in their respective factor spaces from one item area to another.

By way of illustrating stability of loadings for items which have high test-retest canonical correlations, correlations for total scores were selected from Table 2. Plots for these correlations are shown in figures 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 and 16. It can be seen that loadings for two interest areas are quite similar when the canonical correlations are in the 90's. Plots for relatively lower correlations are shown in later sections of this report.

TABLE 2

CANONICAL CORRELATION FOR TEST-RETEST RELIABILITY OVER FIVE WEEK INTERVAL

(N = 89)

Canonical Correlation	INTEREST ITEM AREAS Area 1	2	3	4	5	6	7	8	9	10	11	Factor Total
1	.87	.83	.89	.88	.87	.89	.89	.82	88	.86	.87	.94
2	.79	.80	.86	.84	.80	.89	.84	.80	.83	.83	.80	.94
3	.71	.71	.80	.77	.75	.81	.81	.65	.79	.74	.70	.89
4	.68	.68	.76	.74	.71	.72	.76	.58	.77	.70	.67	.86
5	.67	.67	.71	.68	.63	.66	.74	.57	.61	.62	.62	.82
6	.58	.59	.64	.65	.60	.61	.71	.51	.48	.55	.50	.81
7	.55	.53	.60	.54	.48	.57	.64	.50	.46	.45	.48	.72
8	.51	.45	.58	.50	.42	.40	.62	.38	.36	.32	.39	.68
9	.40	.31	.50	.40	.30	.35	.47	.32	.32	.15	.30	.55
10	.39	.26	.38	.24	.19	.30	.32	.21	.15	.11	.23	.52
11	.23	.22	.30	.19	.14	.17	.29	.12	.09	.09	.20	.26
12	.21	.04	.15	.03	.06	.08	.03	.04	.02	.02	.05	.22

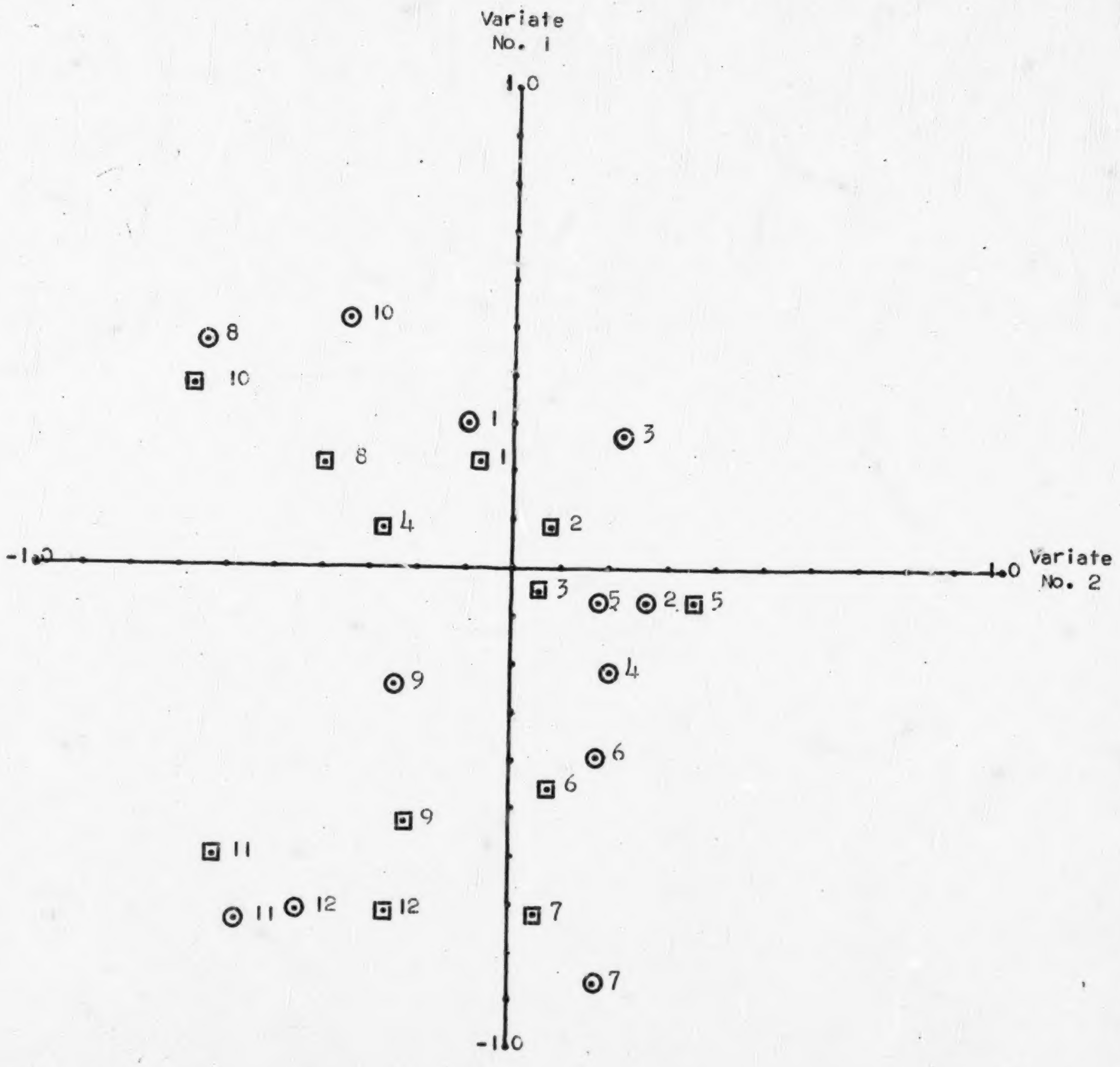


Fig. 2. Plots of loadings for Canonical Variates 1 and 2 from Interest Areas 4 and 7 (see Experimental Instrument, Appendix B). Magnitude of Canonical Correlation for Variate 1 is .80; for Variate 2, .60.

☐ Area 4 ○ Area 7

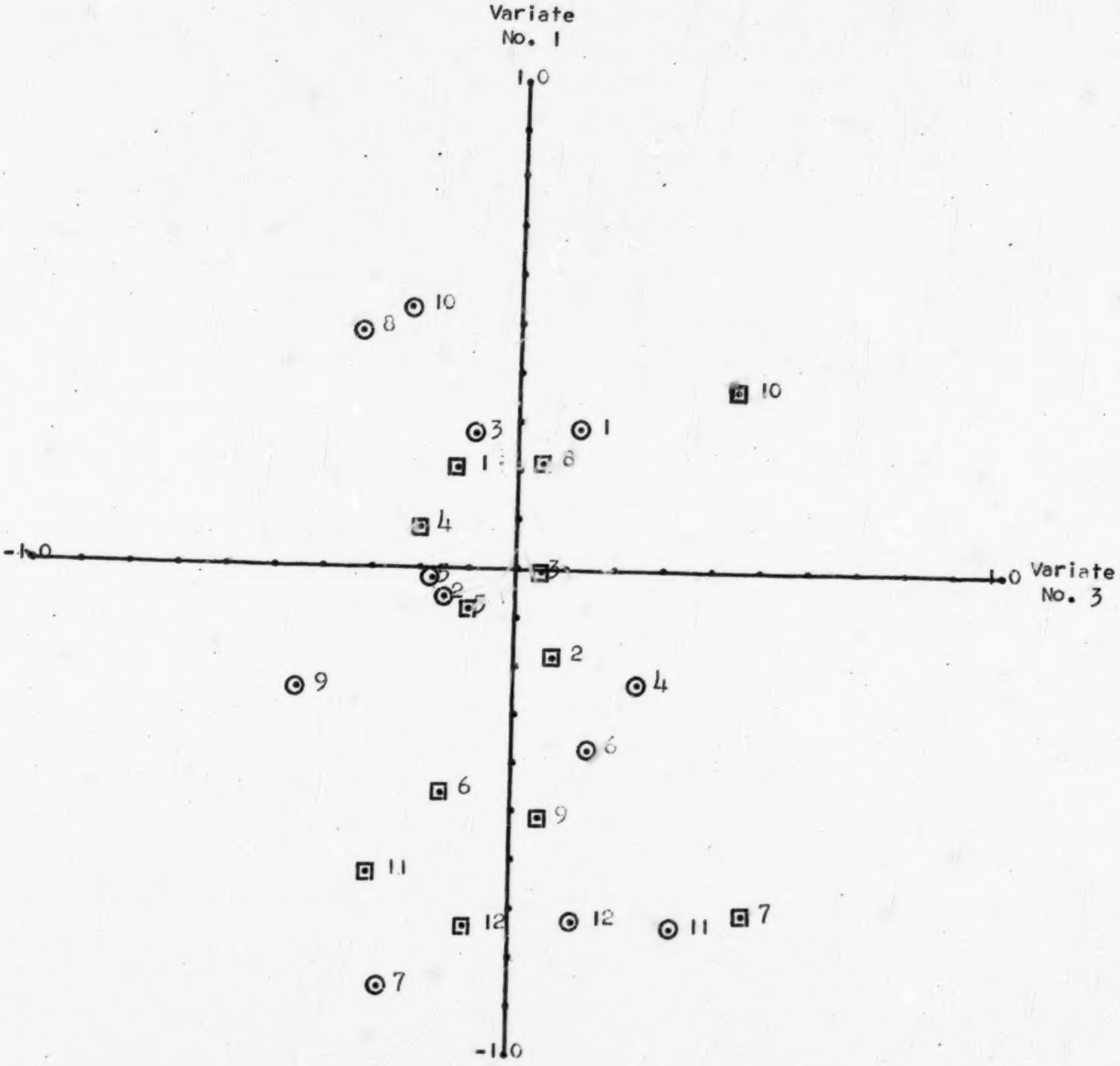


Fig. 3. Plots of loadings for Canonical Variates 1 and 3 from Interest Areas 4 and 7 (see Experimental Instrument, Appendix B). Magnitude of Canonical Correlation for Variate 1 is .80; for Variate 3, .56.

□ Area 4 ○ Area 7

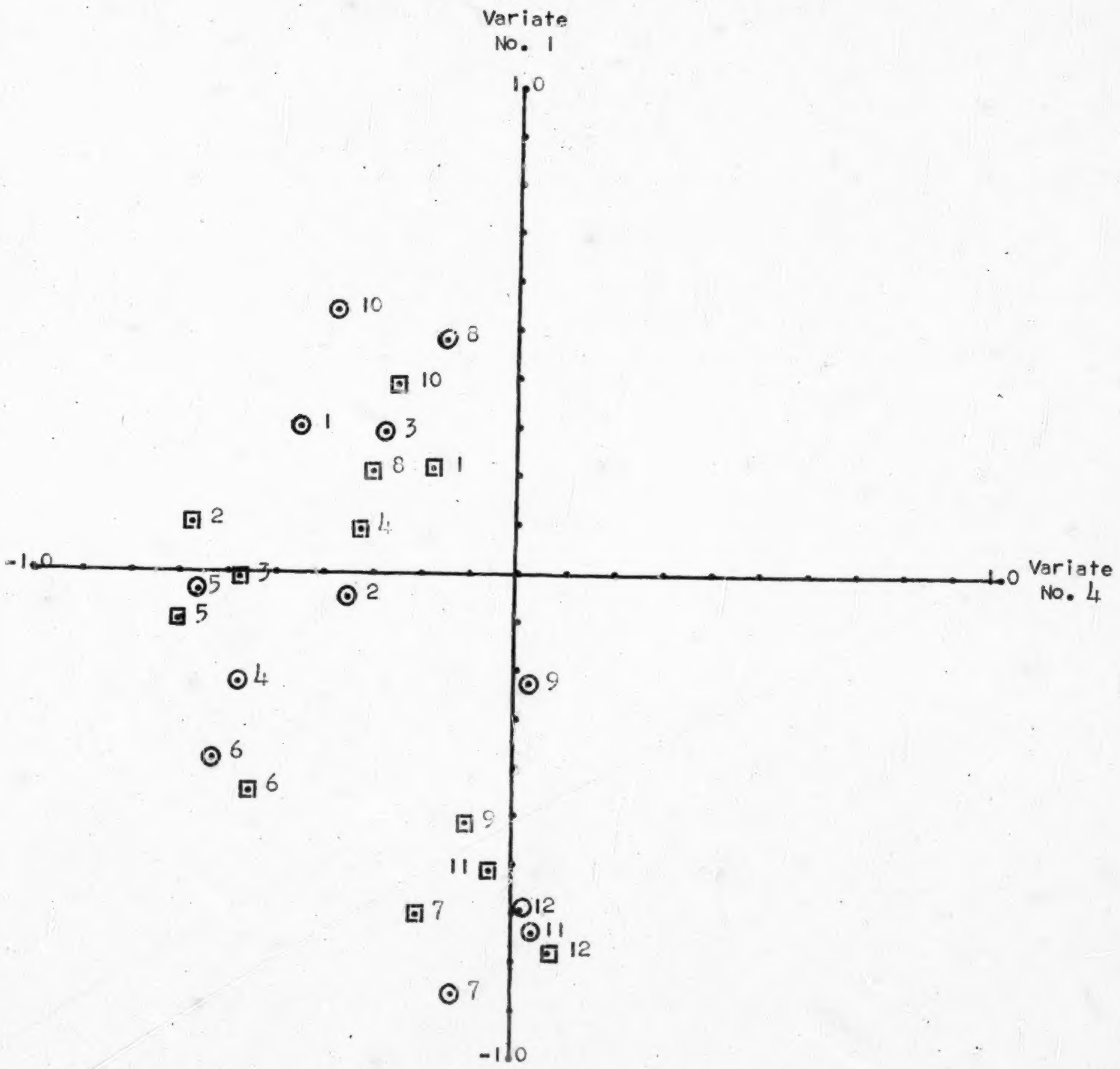


Fig. 4. Plots of loadings for Canonical Variates 1 and 4 from Interest Areas 4 and 7 (see Experimental Instrument, Appendix B). Magnitude of Canonical Correlation for Variate 1 is .80; for Variate 4, .55.

☐ Area 4 ○ Area 7

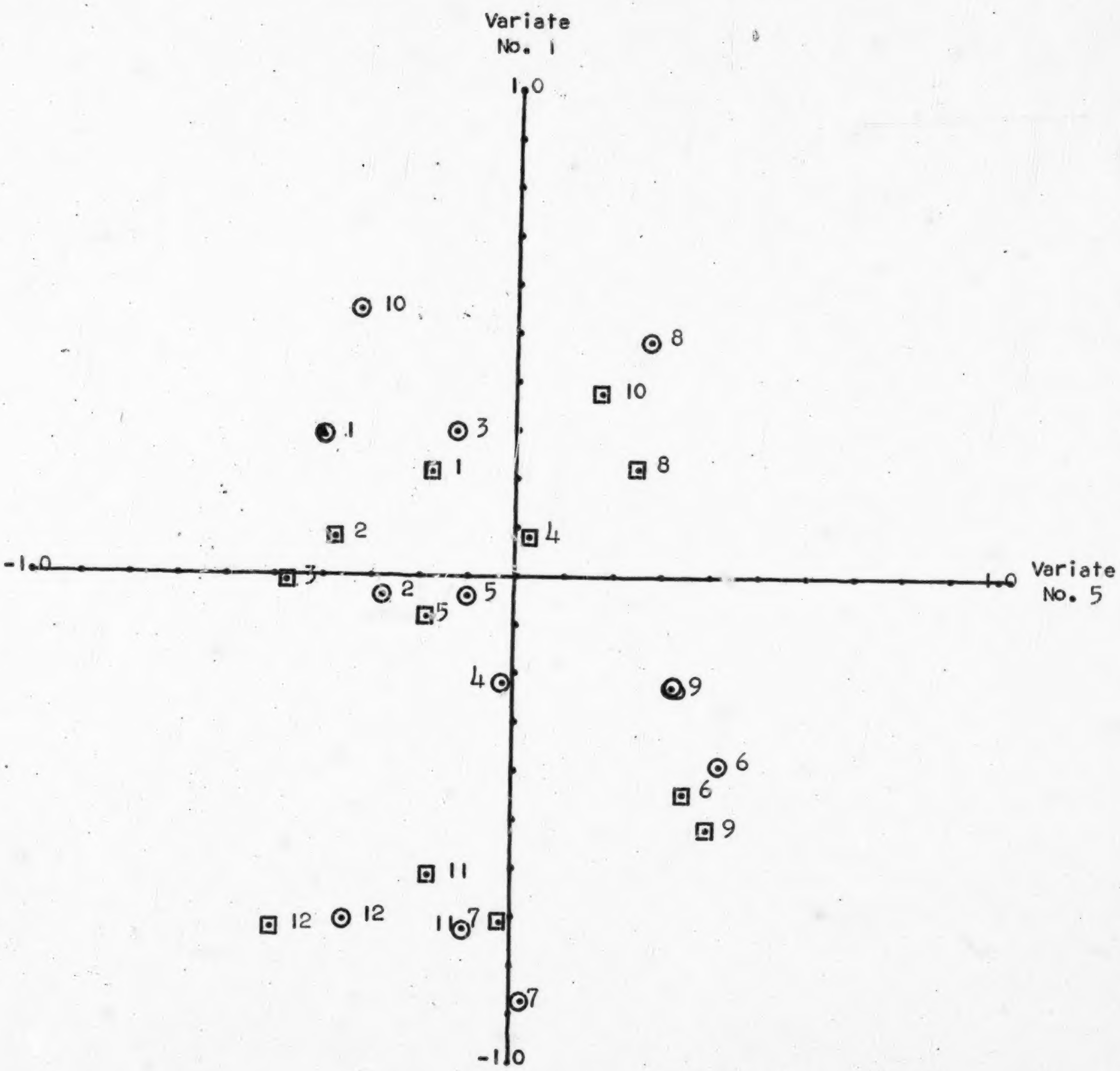


Fig. 5. Plots of loadings for Canonical Variates I and 5 from Interest Areas 4 and 7 (see Experimental Instrument, Appendix B). Magnitude of Canonical Correlation for Variate I is .80; for Variate 5, .43.

☐ Area 4 ○ Area 7

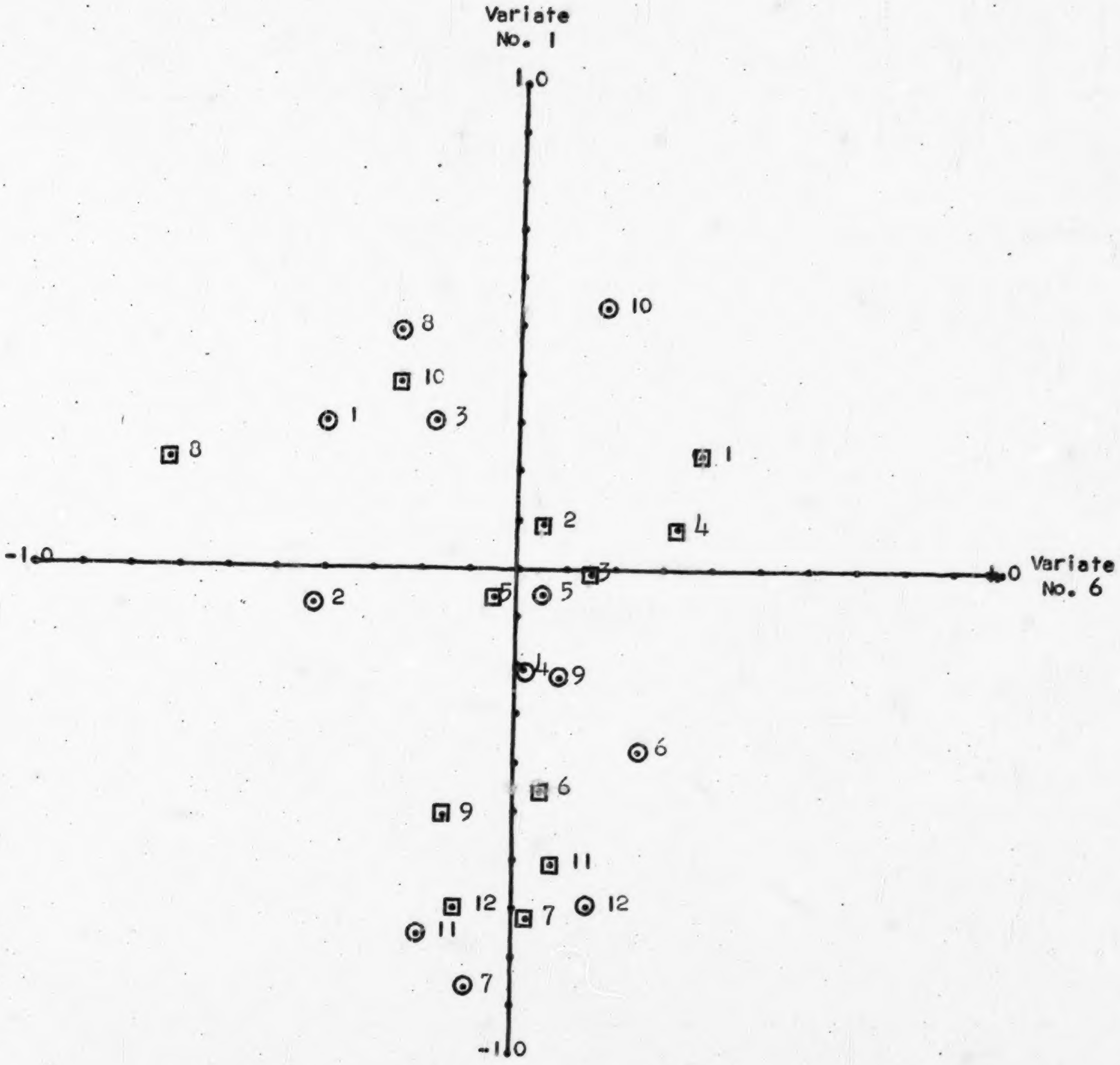


Fig. 6. Plots of loadings for Canonical Variates 1 and 6 from Interest Areas 4 and 7 (see Experimental Instrument, Appendix B). Magnitude of Canonical Correlation for Variate 1 is .80; for Variate 6, .36.

☐ Area 4 ○ Area 7

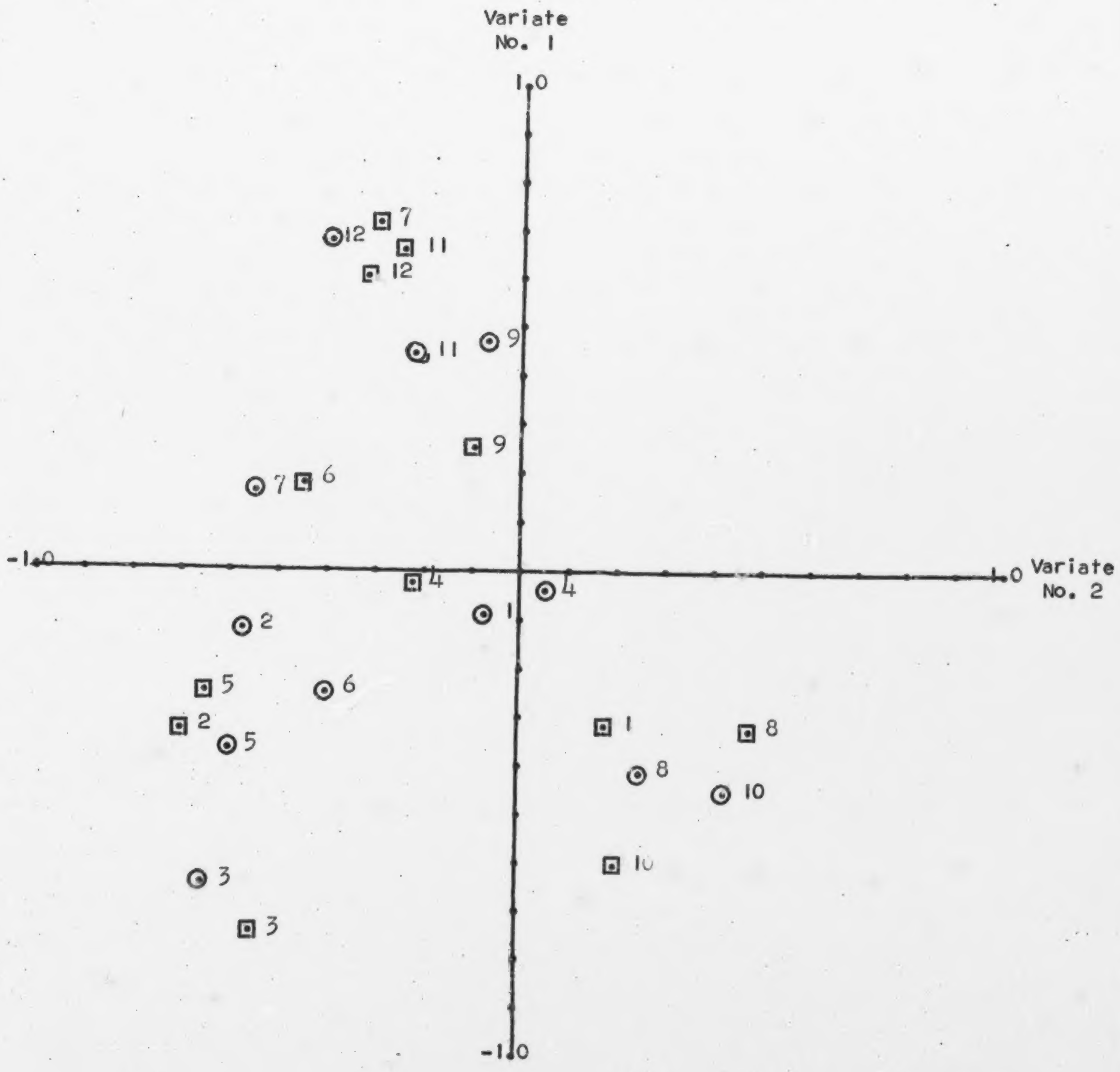


Fig. 7. Plots of loadings for Canonical Variates 1 and 2 from Interest Area 6 and 7 (see Experimental Instrument, Appendix B). Magnitude of Canonical Correlation for Variate 1 is .83; for Variate 2, .76.

☐ Area 7 ○ Area 6

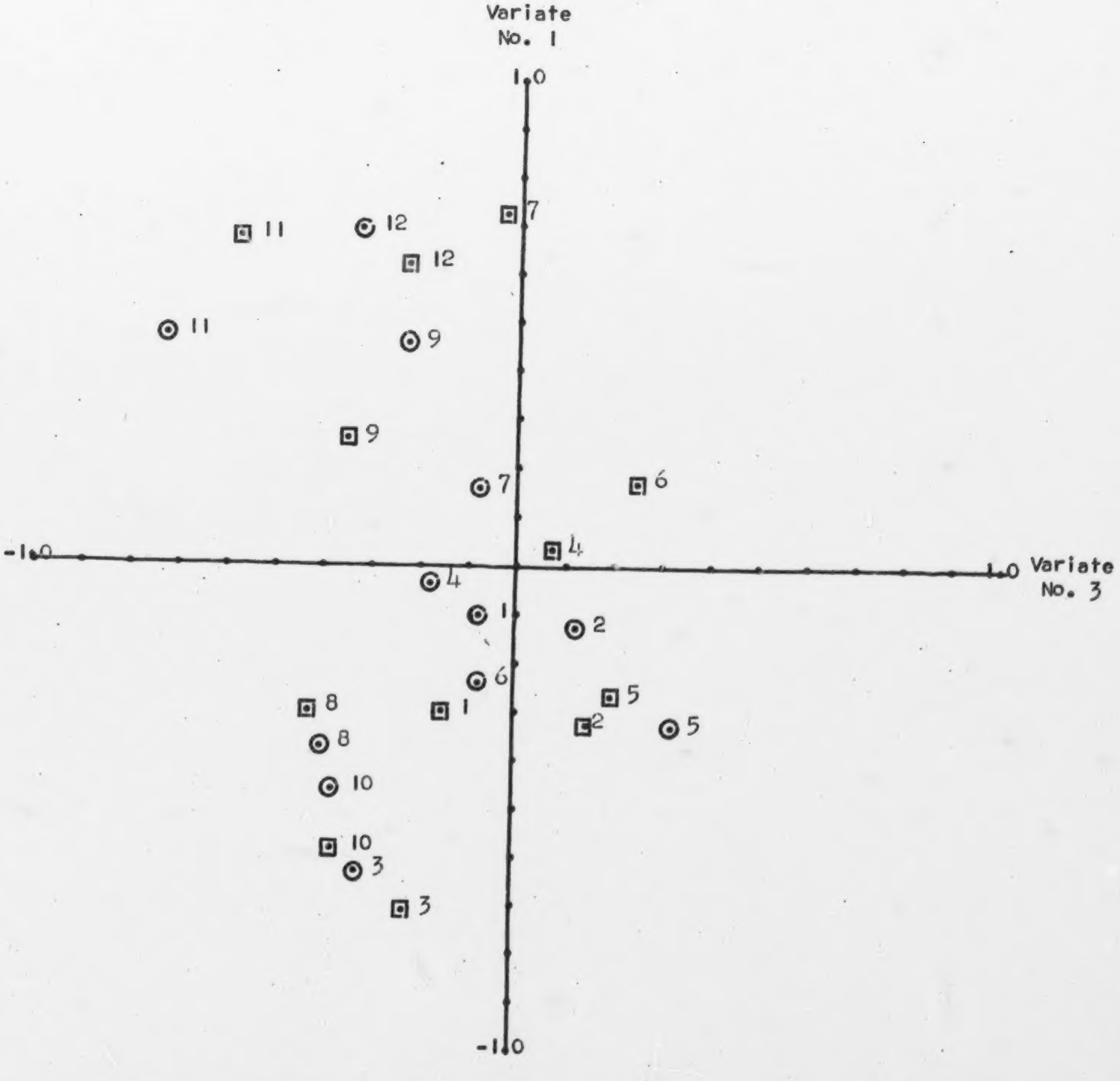


Fig. 8. Plots of loadings for Canonical Variates 1 and 3 from Interest Areas 6 and 7 (see Experimental Instrument, Appendix B). Magnitude of Canonical Correlation for Variate 1 is .83; for Variate 3, .60.

☐ Area 7 ○ Area 6

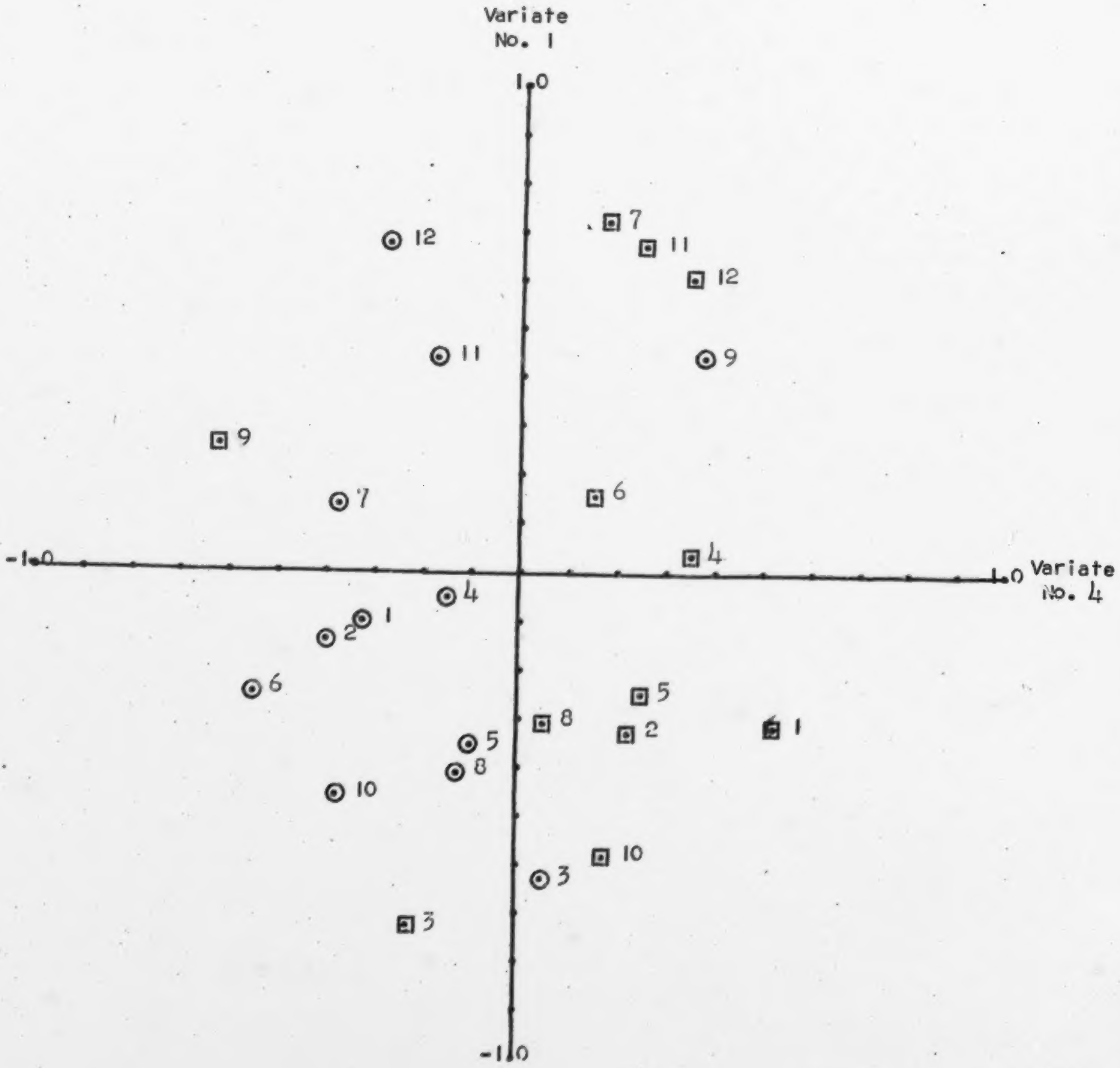


Fig. 9. Plots of loadings for Canonical Variates 1 and 4 from Interest Areas 6 and 7 (see Experimental Instrument, Appendix B). Magnitude of Canonical Correlation for Variate 1 is .83; for Variate 4, .52.

○ Area 6 ☐ Area 7

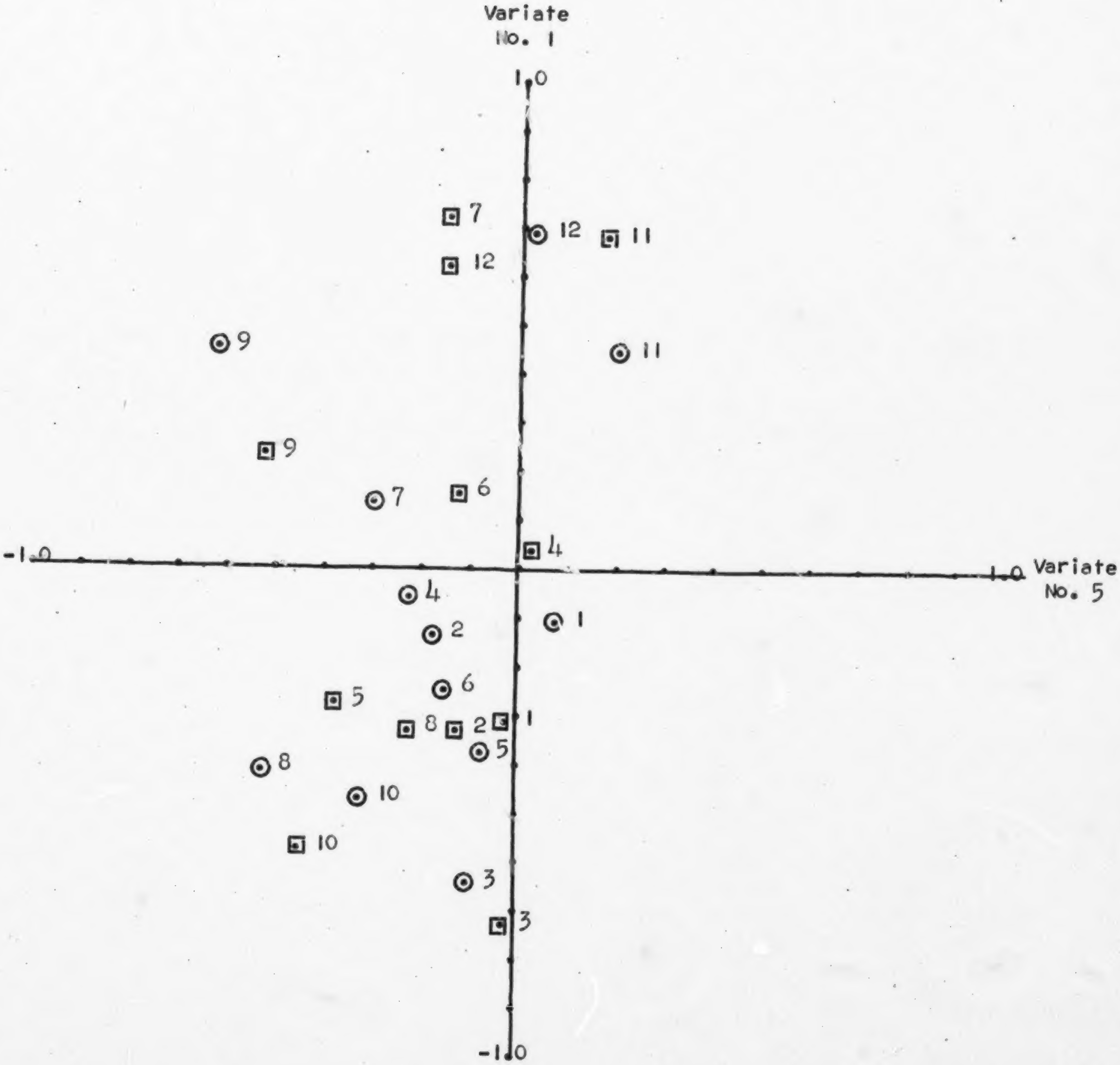


Fig. 10. Plots of loadings for Canonical Variates 1 and 5 from Interest Areas 6 and 7 (see Experimental Instrument, Appendix B). Magnitude of Canonical Correlation for Variate 1 is .83; for Variate 5, .39.

□ Area 7 ○ Area 6

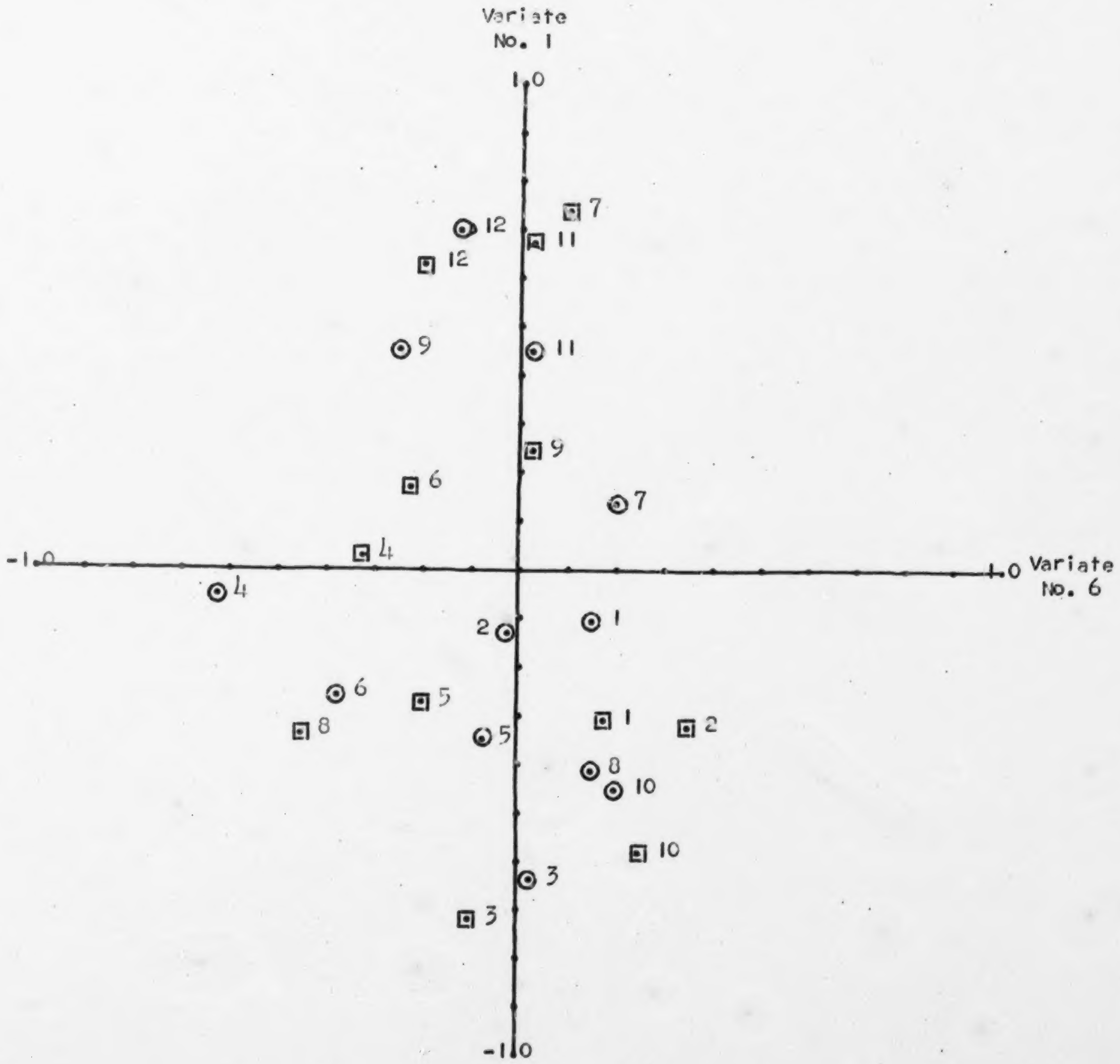


Fig. 11. Plots of loadings for Canonical Variates 1 and 6 from Interest Areas 6 and 7 (see Experimental Instrument, Appendix B). Magnitude of Canonical Correlation for Variate 1 is .83; for Variate 6, .35.

☐ Area 7 ○ Area 6

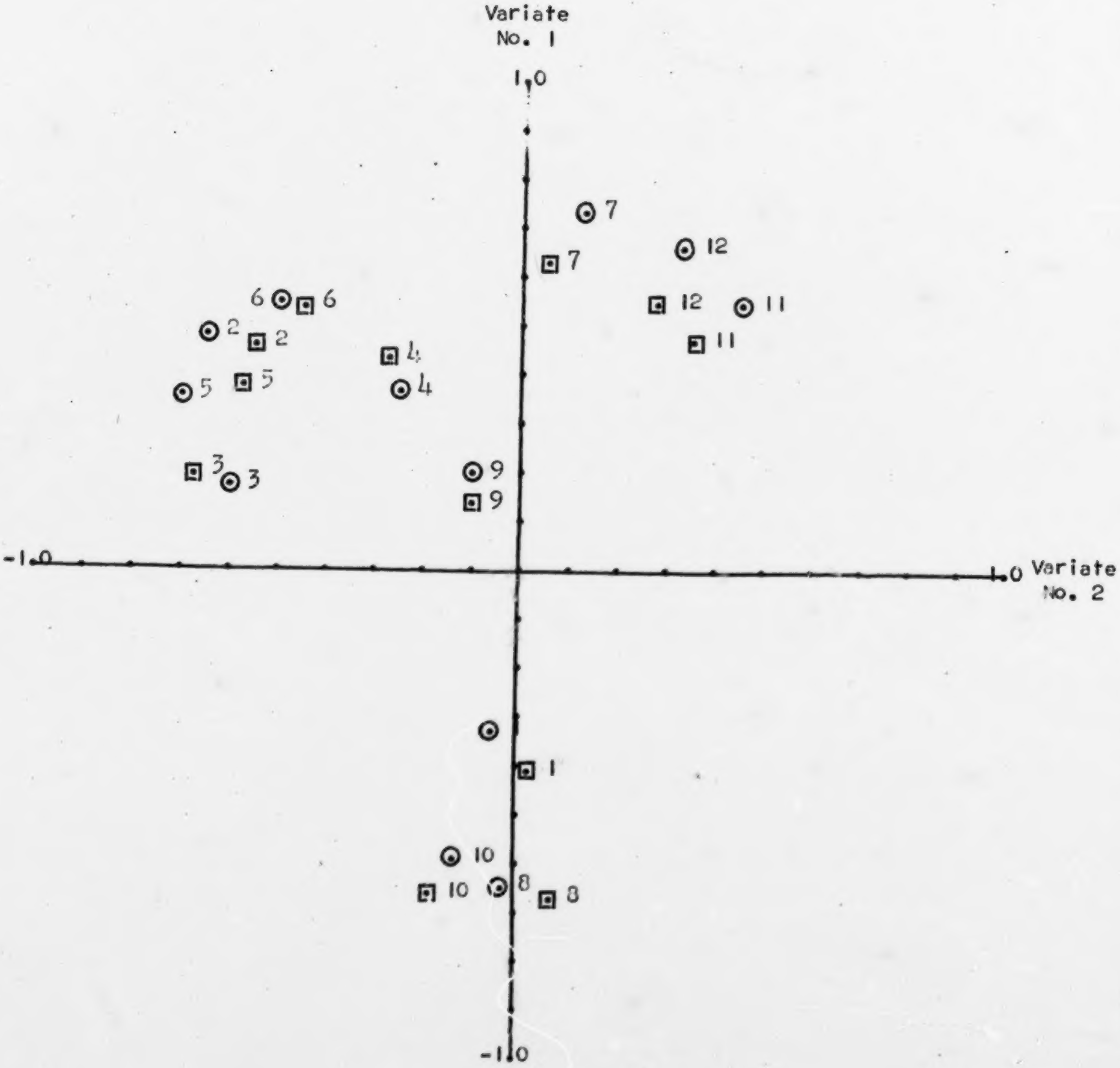


Fig. 12. Plots of loadings for Canonical Variates 1 and 2 for scores summed for the 12 Factors (see Table 2). Magnitude of Canonical Correlation for Variate 1 is .94; for Variate 2, .94.

☐ Pre-test ○ Post-test

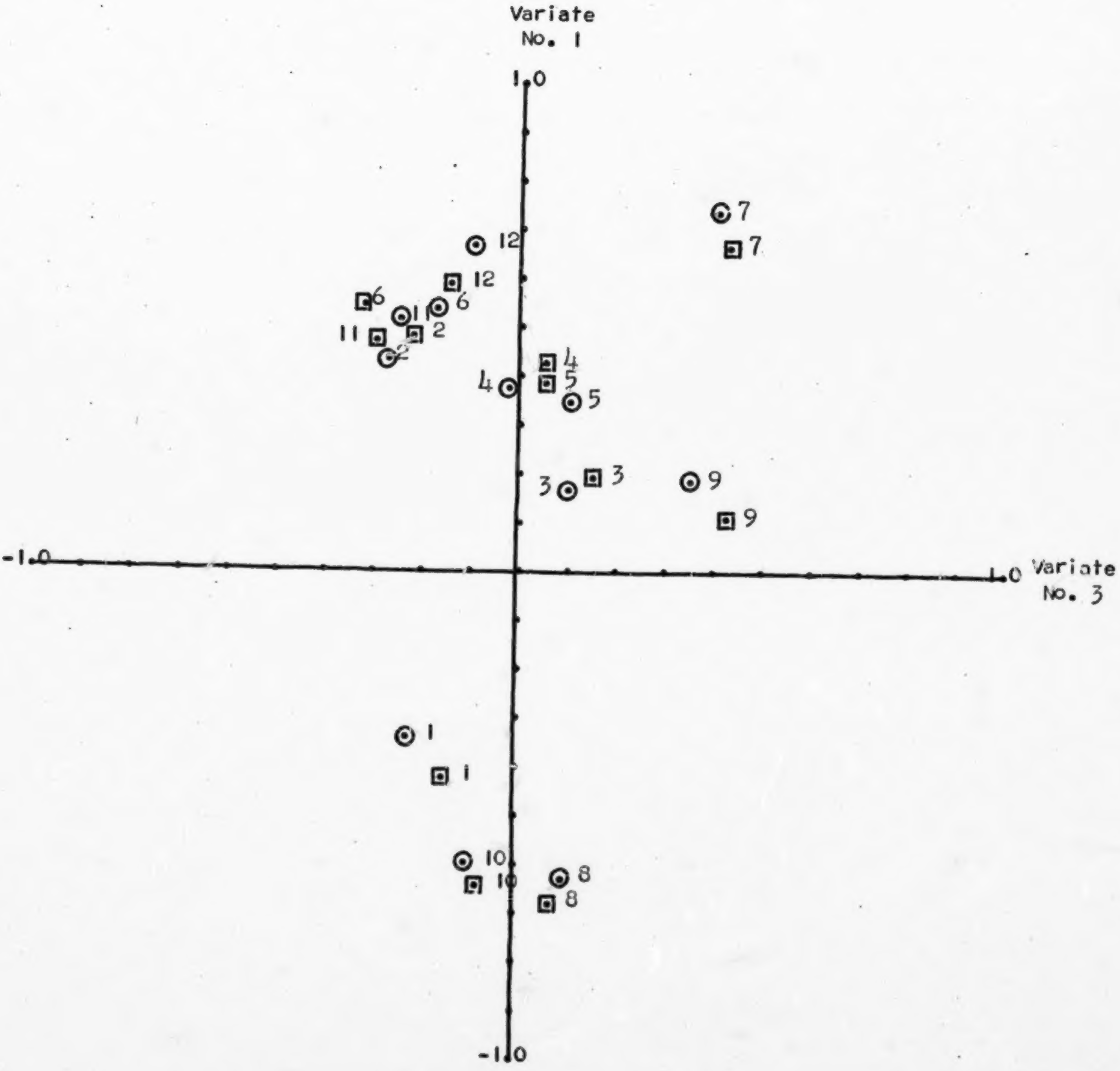


Fig. 13. Plots of loadings for Canonical Variates 1 and 3 for the scores summed for the 12 Factors (see Table 2). Magnitude of Canonical Correlation for Variate 1 is .94; for Variate 3, .89.

□ Pre-test ○ Post-test

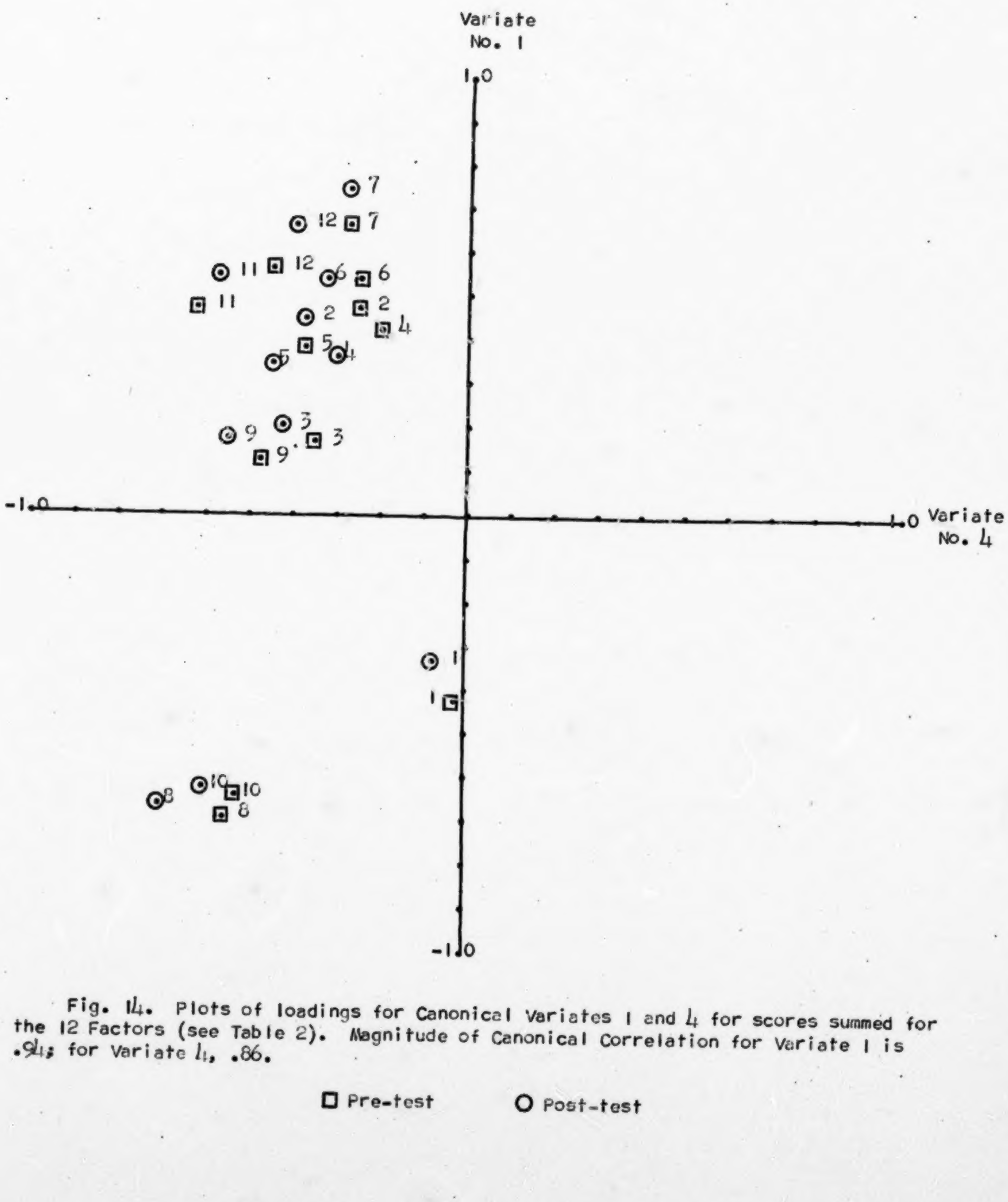


Fig. 14. Plots of loadings for Canonical Variates 1 and 4 for scores summed for the 12 Factors (see Table 2). Magnitude of Canonical Correlation for Variate 1 is .94; for Variate 4, .86.

□ Pre-test ○ Post-test

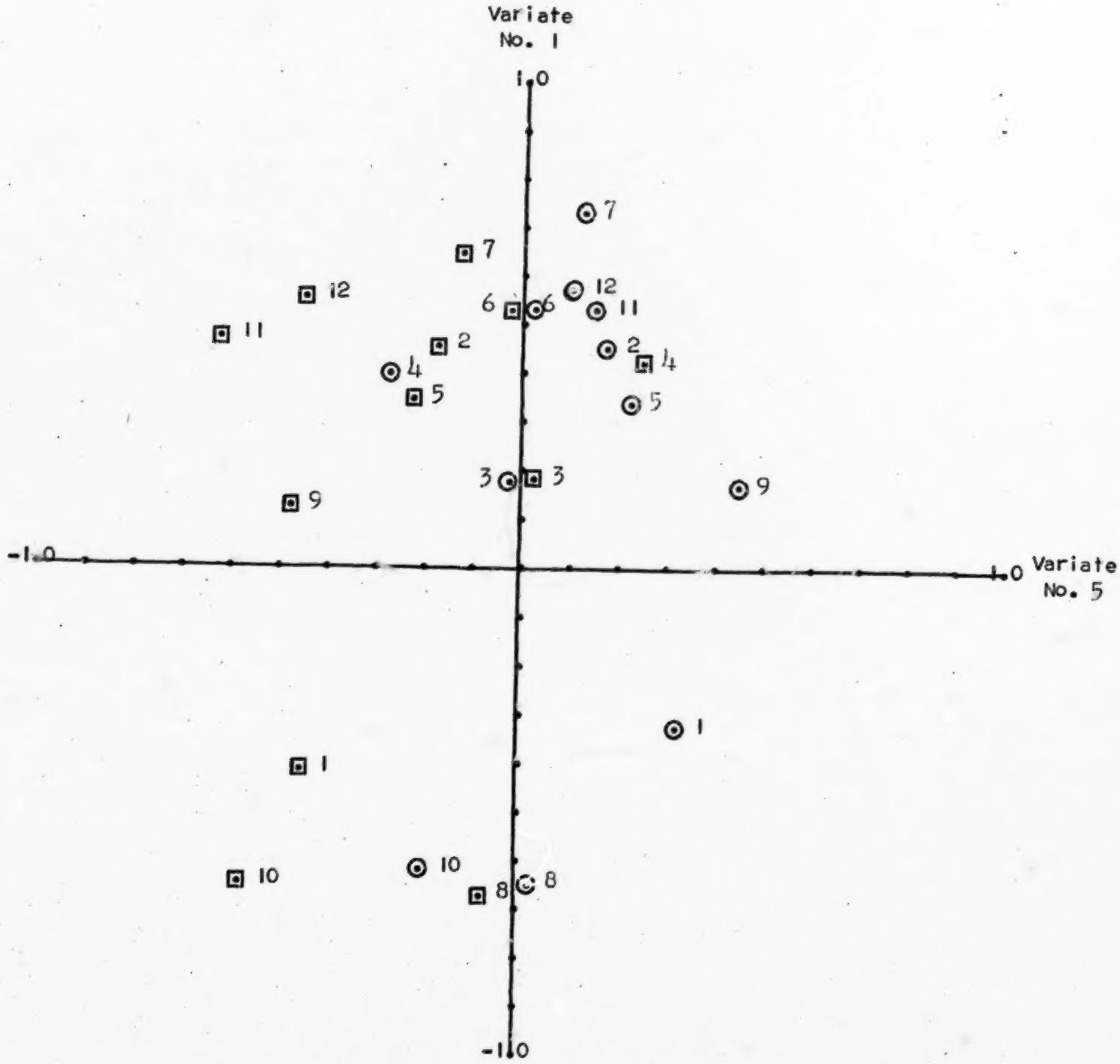


Fig. 15. Plots of loadings for Canonical Variates 1 and 5 for scores summed for the 12 Factors (see Table 2). Magnitude of Canonical Correlation for Variate 1 is .94; for Variate 5, .82.

☐ Pre-test ○ Post-test

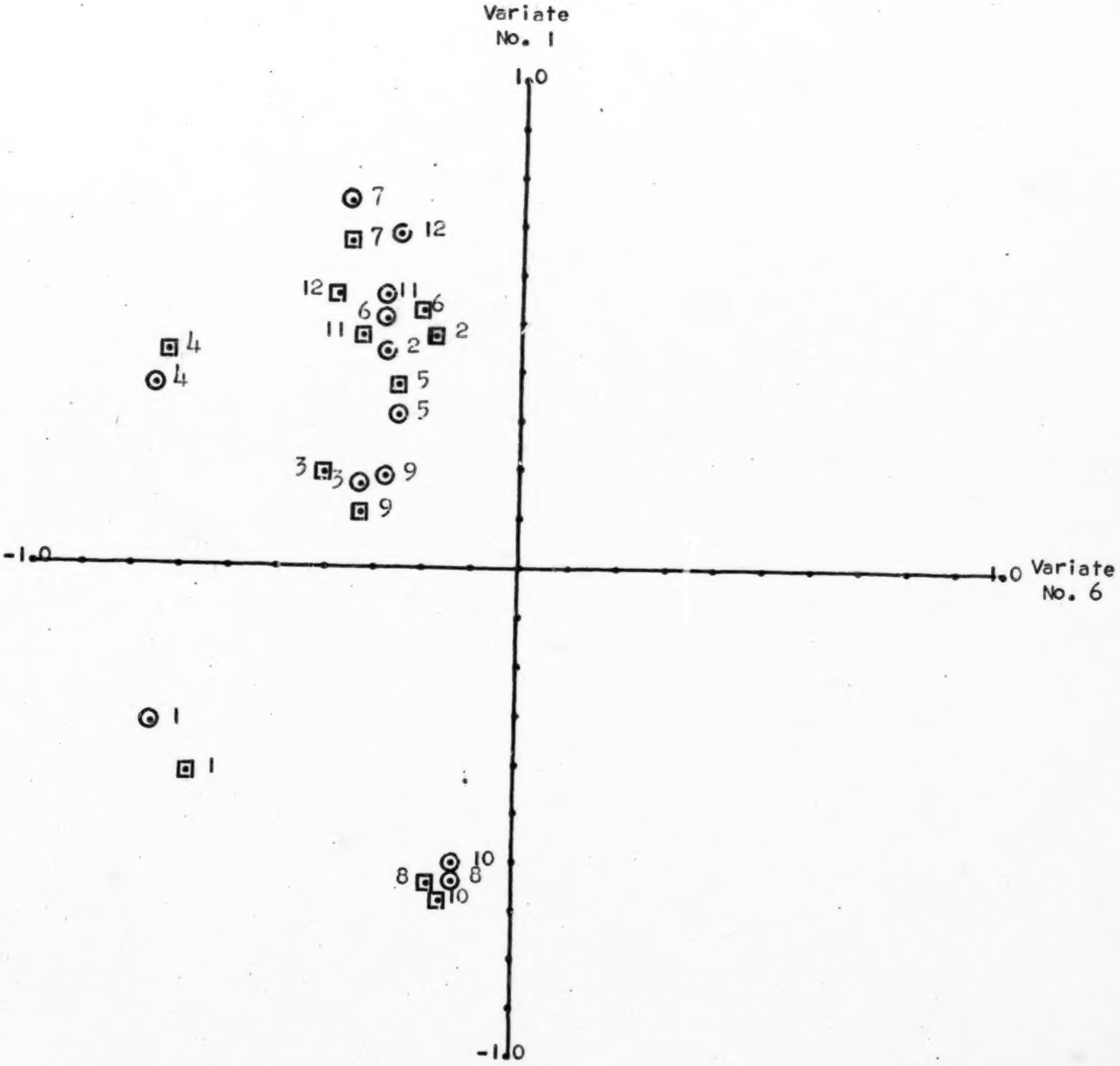


Fig. 16. Plots of loadings for Canonical Variates 1 and 6 for scores summed for the 12 Factors (see Table 2). Magnitude of Canonical Correlation for Variate 1 is .94; for Variate 6, .81.

□ Pre-test ○ Post-test

It should be remembered that canonical correlations provide maximum correlations between linear composites of the two sets of variates. For comparative purposes, the usual test-retest Pearson correlations for items and total factor scores were computed. These correlations are presented in Table 3. The reliability of the items is satisfactory. With only eight exceptions all test-retest correlations for items exceeded .40. The reliabilities for the total scores are all above .78. Thus, both items and total scores have considerable longitudinal stability.

In summary, the question concerning the stability of the factor structure must be answered affirmatively. The factor structure was stable for three independent samples. Furthermore, for one of these samples it remained stable over a period of five weeks.

Factor Structure Underlying Item Areas (Interest Categories)

Does the factor structure of the scales within one item category differ from the factor structure of the scales within another item category? This question, of course, was the central concern of this study. The first evidence concerning the similarity of factor structure underlying the item categories or areas was obtained from Wilks' (1946) criterion for parallel tests, L_{vc}. The term "test" here refers to an item in a given a priori factor, since the analyses performed were to determine whether items written for each factor were, in fact, miniature parallel tests. If, when variances are held constant, L_{vc} is near unity, the covariances for the various tests would be quite similar and thus the factor structures would be identical. If L_{vc} approaches zero, then the factor structures would not be similar.

TABLE 3

TEST-RETEST CORRELATION[1] FOR ITEMS AND FOR FACTOR TOTALS

AREA FACTOR	1	2	3	4	5	6	7	8	9	10	11	Factor Total
1	.45	.55	.47	.64	.63	.46	.75	.50	.55	.62	.58	.78
2	.60	.40	.56	.56	.53	.58	.78	.40	.42	.45	.43	.79
3	.60	.55	.60	.75	.60	.75	.73	.48	.58	.26	.61	.80
4	.62	.55	.64	.64	.68	.46	.69	.53	.47	.41	.46	.80
5	.69	.51	.60	.58	.43	.52	.76	.58	.51	.46	.55	.84
6	.57	.61	.66	.65	.38	.63	.57	.48	.72	.53	.58	.81
7	.60	.38	.61	.56	.47	.70	.71	.49	.74	.50	.65	.85
8	.54	.55	.72	.63	.63	.70	.58	.46	.39	.50	.65	.83
9	.36	.51	.77	.52	.44	.39	.49	.43	.48	.70	.52	.79
10	.67	.58	.80	.65	.65	.58	.22	.36	.52	.47	.54	.81
11	.56	.62	.60	.60	.54	.69	.67	.45	.68	.56	.46	.87
12	.46	.47	.55	.63	.44	.64	.66	.59	.44	.72	.65	.79

---

[1] Correlations are Pearson Product-Moment

The results of the Wilks' analysis are shown in Table 4. None of the L_{vc}'s reached the level of .64 which was required to conclude that the tests (items) were parallel. Thus, on the basis of Wilks' test, it is necessary to conclude that the factor structures underlying the various item categories within a priori factors are not parallel.

A second source of evidence bearing on the factor structure of item areas was obtained by computing canonical correlations among all possible combinations of the item areas. As shown in Appendix C, there were 55 such combinations. In order that the magnitudes of the correlations might be more easily observed, the first canonical correlation for each of the 55 combinations has been entered in Table 5. The next five canonical correlations have been entered in Tables 6, 7, 8, 9 and 10, respectively.

The magnitudes of obtained correlations are fairly high, considering the fact that the correlations were computed on item areas. These correlations appear to be of sufficient magnitude to justify combining, for a number of analyses included in this report, items from the 11 areas into scales for the appropriate factor.

The results of the two analyses, the Wilks' criterion test and the canonical correlation, appear to be somewhat contradictory. Perhaps the difference can be explained by the item analysis data shown in Appendix D. Obviously, a small number of items were misplaced with respect to the factors, and some of the items should be discarded or revised. These faulty items would tend to lower the value of the L_{vc}.

TABLE 4

WILKS' CRITERION TEST FOR PARALLEL ITEMS FOR FACTORS[1]

FACTOR NUMBER	L_{vc}[2]
1	.50
2	.59
3	.30
4	.52
5	.45
6	.51
7	.39
8	.45
9	.43
10	.50
11	.31
12	.37

[1] Based on the original sample (N = 188)

[2] Variance held constant

The number of significant canonical correlations obtained for any combination of interest areas provides an indication of the number of significant factors underlying the two areas. Thus, since there are 12 canonical correlations for each combination of areas, it is of interest to determine which of the 12 are significantly different from zero. Fortunately, there are a number of significance tests available.

The significance test advocated by Marriott (1952) is Bartlett's (1938) extension of the Wilks' lambda for total set test (1932), a likelihood ratio test.

$L = \prod_{i=1}^{p} (1 - r_i^2)$, where r_i is the i th canonical correlation. When the first root is removed, the value of Wilks' lambda is $L' = \prod_{i=2}^{p} (1 - r_i^2)$ and so on until only one root remains. When the number of variates $p > 2$, no exact test of significance is available. Bartlett (1938) developed the following approximate test.

$$\chi^2_{pq} = - \{N - \tfrac{1}{2} (p + q + 1)\} \log_e L$$

with p q degrees of freedom

where p and q refer to the orders of the correlation matrices R_{aa} and R_{bb}

As can be seen from Appendix C, when computed by the method described above, the significance level varies considerably from one area combination to another. This is troublesome, since an equal number of variates and the same number of subjects were used for each analysis. In one instance, a correlation of .39 is significant at the .01 level; with another combination, .51 is significant at the .05 level. The difficulty lies in the fact that the chi square for the first canonical correlation is based upon the other 11 variates. The chi square for the second canonical correlation is based on all canonical correlations exclusive of the first, and so on. Thus, in computing the chi squares, information is included from a number of correlations which are not significantly different from zero.

For purposes of this study, a more satisfactory significance test, in that significance reflects only the large canonicals and thus is not affected by non-significant correlations, has been proposed by Kullback (1959). His test, based on the number of subjects and the number of variates in the predictor and criterion sets, is as follows:

$(N - k_1)\ r_1^2 / (1 - r_1^2)$ Where N = number of subjects
and k = number of variates

In this study, $N = 188$; $k_1 = k_2 = 12$

The above quantity is distributed as chi square with $k_1 + k_2 - 2$ degrees of freedom. The formula for determining the significance of the i th canonical correlation is:

$$(N - k_1)\ r_i^2 / (1 - r_i^2) \quad \text{with} \quad df = k_1 + k_2 - 2i$$

Required magnitudes for canonical correlations for significance at the .05 and .01 levels, based on the original sample of 188 male subjects and 12 variates, are shown in Table 11.

By applying the significance levels in Table 11 to the canonical correlations in Appendix C, it appears that six factors can account for the significant relationships among the various combinations of interest areas.

Factor plots of loadings for interest area combinations 4-7 and 6-7 and for summed factor scores from the reliability data are shown in Figures 2 through 16. Only the loadings for the first six canonical correlations are given for each combination. The loadings for the various items remain quite stable from one interest area to another.

One of the questions raised when this study was initiated was: If the factor structures underlying interest categories are not similar, then what are feasible ways of utilizing information from such disparate categories? In view of the finding that the factor structures are similar, this question is no longer relevant.

Comparison of Equisection Scales with Scales Developed by a Paired Comparison Technique

Is the factor structure obtained from scales developed by an equisection technique similar to the factor structure obtained from scales developed by a paired comparison technique?

Each item in a given item category was paired with each of the other 11 items in that category, a total of 66 combinations. The pairs

TABLE 11

MAGNITUDE OF CANONICAL CORRELATION COEFFICIENTS REQUIRED FOR SIGNIFICANCE AT THE .01 AND .05 LEVELS BASED ON KULLBACK TEST FOR ORIGINAL SAMPLE OF 188 SUBJECTS

cc #	df	$\chi^2_{.05}$	$r_{.05}$	$\chi^2_{.01}$	$r_{.01}$
1	22	33.92	.40	40.29	.43
2	20	31.41	.39	37.57	.42
3	18	28.87	.38	34.80	.41
4	16	26.30	.36	32.00	.39
5	14	23.68	.34	29.14	.38
6	12	21.03	.33	26.22	.36
7	10	18.31	.31	23.21	.34
8	8	15.51	.28	20.09	.32
9	6	12.59	.26	16.81	.30
10	4	9.49	.23	13.28	.26

were arranged in the optimum order as described by Ross (1934). Each pair was replicated five times by each subject, or a total of 330 pairs. Thurstone's (1927) case V method of analysis was used. Torgerson's (1958) computational procedure for an incomplete matrix was followed. If the proportion falling in a given cell was 1.00, plus 2 was substituted for the normal deviate; if the proportion was .00, minus 2 was substituted.

Approximately 50 subjects completed the experimental instrument and the paired comparisons for each item category. The N's varied somewhat because a small number of subjects made errors in recording their responses. These subjects were eliminated from the analysis. Item category XI (armed services) was omitted from this analysis because the items were deemed inappropriate for the women subjects.

The canonical correlations between the scales developed by the paired comparison technique and those developed by the equisection technique are shown in Table 12. Eight of the ten first canonical correlations were .90 or higher. The lowest one was .845. The magnitudes of the obtained correlations indicate that the factor structures of the scales developed by the two methods are practically identical.

Relationship Between the Experimental Scales and Other Measures of Interest

Although not a basic part of this study, it was of interest to know the relationship between the equisection type interest scale and the long established SVIB and the KPR, which were offered to the subjects as an inducement to complete the experimental instrument. SVIB scores were available for 153 subjects who also had completed correctly the experimental scales.

TABLE 12

CANONICAL CORRELATIONS FOR PAIRED COMPARISON AND AREA ANALYSIS

	N=54	N=53	N=49	N=51	N=49	N=50	N=51	N=50	N=50	N=50
Area	1	2	3	4	5	6	7	8	9	10
Canonical Coefficient										
1	.91	.84	.96	.90	.90	.91	.97	.94	.97	.89
2	.85	.78	.93	.84	.90	.82	.95	.90	.94	.85
3	.77	.76	.91	.79	.75	.79	.89	.84	.91	.78
4	.70	.70	.88	.75	.67	.78	.86	.78	.88	.73
5	.63	.61	.85	.64	.61	.69	.81	.77	.83	.69
6	.58	.57	.80	.60	.60	.68	.74	.70	.79	.62
7	.47	.51	.78	.54	.53	.49	.73	.61	.70	.57
8	.42	.43	.73	.51	.45	.45	.66	.52	.63	.39
9	.35	.30	.55	.41	.24	.41	.58	.44	.58	.33
10	.21	.19	.48	.29	.19	.29	.56	.38	.44	.28
11	.17	.09	.39	.12	.11	.19	.38	.09	.31	.23
12	.03	.03	.10	.11	.04	.14	.13	.08	.09	.17

Sixteen scales from the SVIB were included in the analysis. From the Strong groups, which contained several scales, the scale with the largest intercorrelation with the other scales in the group and the one with the lowest intercorrelation were selected. Selection was based on information reported by Strong (1943). For groups containing a small number of scales only one scale was included from each.

The following scales were used:

Group I	Architect Physician
Group II	Physicist Engineer
Group III	Production Manager
Group IV	Farmer Printer
Group V	YMCA Secretary City School Superintendent
Group VI	Musician
Group VII	CPA Partner
Group VIII	Office Worker Banker
Group IX	Real Estate Salesman
Group X	Author-Journalist
Group XI	President - Manufacturing Concern

The canonical correlations between the experimental scales and those selected from the SVIB are shown in Table 13. The first canonical correlations for item areas range from .63 for area two to .83 for area seven. When the item categories were combined into total factor scores,

TABLE 13

CANONICAL CORRELATION FOR AREAS, FACTOR TOTAL AND SVIB

N = 153*

Canonical Correlation	Area 1	2	3	4	5	6	7	8	9	10	11	Factor Total
1	.72	.63	.77	.78	.64	.81	.83	.77	.72	.67	.77	.88
2	.63	.59	.64	.67	.59	.80	.77	.70	.69	.63	.70	.86
3	.57	.46	.62	.58	.55	.58	.71	.59	.59	.56	.63	.77
4	.49	.42	.52	.52	.45	.54	.63	.46	.51	.46	.54	.63
5	.43	.39	.44	.45	.38	.46	.55	.40	.43	.40	.46	.55
6	.39	.33	.42	.43	.34	.37	.48	.36	.38	.36	.44	.48
7	.36	.28	.36	.35	.32	.34	.39	.32	.31	.32	.35	.39
8	.32	.26	.31	.31	.31	.30	.35	.28	.28	.27	.31	.36
9	.30	.19	.26	.21	.21	.20	.31	.22	.25	.22	.26	.30
10	.22	.15	.21	.20	.17	.15	.27	.21	.22	.16	.21	.27
11	.15	.10	.14	.12	.11	.12	.12	.17	.12	.11	.10	.22
12	.11	.06	.08	.08	.09	.02	.11	.04	.05	.05	.05	.12

---

*This number includes 99 males from the original sample plus 54 males and females from the reliability sample.

the first canonical correlations increased to .88. Thus, on the basis of the above correlations, the factors underlying the SVIB scales and those on the experimental instrument are quite similar.

Scores on the KPR were available for 32 subjects who had also correctly completed the experimental instrument. Canonical correlations between the KPR scales and the equisection scales are shown in Table 14.

The first correlations for item categories or areas ranged from .87 to .99; the median correlation was .95. For the total factor scores, the first correlation was .97. These results are what might be expected on the basis of previously discussed relationships with the SVIB. Yet, because of the small N on which the findings are based, they should be interpreted with caution.

Item Analysis

Items were correlated with total scores for each of the 12 factors. The factor score for which the particular item was intended was corrected for that item $(r_{n,T-n})$ to eliminate spurious correlations. The correlations between item scores within a particular factor and the total scores in that factor are shown in Appendix D. Correlations of item scores with all total factor scores are shown in Appendix E. In general, the item-factor correlations are quite satisfactory. However, perusal of these correlations indicates that item Area II, "Yearbook Inscriptions", should either be revised or eliminated. It

TABLE 14

CANONICAL CORRELATION FOR AREAS, FACTORS AND KUDER

N = 32

Canonical Correlation	Area											Factor Total
	1	2	3	4	5	6	7	8	9	10	11	
1	.97	.87	.99	.95	.91	.98	.96	.95	.95	.87	.93	.97
2	.92	.80	.93	.94	.88	.90	.95	.94	.90	.84	.91	.96
3	.87	.77	.88	.89	.77	.88	.90	.89	.85	.83	.86	.91
4	.86	.67	.75	.83	.73	.80	.90	.82	.80	.75	.72	.82
5	.70	.58	.69	.74	.67	.74	.78	.76	.76	.68	.62	.78
6	.61	.52	.68	.56	.51	.68	.75	.61	.65	.58	.53	.71
7	.50	.42	.60	.48	.45	.56	.58	.56	.54	.52	.52	.55
8	.43	.34	.36	.43	.32	.44	.54	.37	.45	.37	.33	.37
9	.36	.20	.14	.28	.22	.35	.26	.33	.31	.17	.16	.20
10	.24	.13	.04	.14	.12	.23	.12	.15	.04	.15	.04	.09

also appears that factor 11, "aesthetic appreciation", and factor 12, "aesthetic expression", should be collapsed into one aesthetic factor. In addition, factor 8, "concrete, non-operative means", and factor 10, "concrete, operative means", were not clearly differentiated.

CONCLUSIONS AND IMPLICATIONS

CONCLUSIONS AND IMPLICATIONS

The conclusions and implications will be discussed in relation to the questions posed in the statement of the problem.

1. Will the equisection procedures yield stable and reliable results?

The results justify the conclusion that interests can be successfully measured by equisection procedure. Resulting scales have quite satisfactory test-retest reliability and are stable from sample to sample.

This conclusion has a number of implications for the measurement of interests. Perhaps, most important of these is that the equisection procedure results in an interval scale. As has been indicated earlier in this report, scores on such scales are amenable to a wider variety of statistical analyses than are scores from other types of interest scales.

The high reliability of the scales has important implications for the development of scales of non-cognitive attributes other than interest. Item redundancy has long been a problem in the development of personality scales. On several instruments, one can find scales ranging in length from 25 to well over 100 items. Undoubtedly, as pointed out by Clark (1961), many existing scales could be reduced in length rather drastically without greatly reducing reliability. If the equisection procedure could be applied successfully within the personality realm, then it might be possible to greatly reduce the length of the scales and yet have quite reliable measures.

The reliability of the interest scales produced for this study were surprisingly high considering the fact that each scale contained only 11 items.

Equisection procedures yield scales which avoid the spurious correlations built into ipsative scales, such as the KPR or the Allport-Vernon-Lindsay Study of Values, or into SVIB scales which are based on a common item pool. In the experimental instrument used in this study, an item is scored for only one given factor. Thus, in the absence of spurious correlations, it should be relatively easy to identify the factor structure underlying the scales.

2. Is the factor structure obtained from scales developed by an equisection procedure similar to the factor structure obtained by means of a paired comparison procedure?

The results justify the conclusion that the factor structure obtained by the two procedures are quite similar.

Since the paired comparison method is noted for its reliability as a scaling technique, this similarity provides further indication that the equisection scaling procedures are highly reliable. The relationship also indicates that the equisection procedure yields interval scales.

3. Does the factor structure of the scales within one item category differ from the factor structure of another item category?

The findings appear to justify a tentative conclusion that the factor structures are similar; therefore, the question must be answered negatively.

As indicated in the discussion of the findings, the evidence is somewhat contradictory on this question. The item categories were not found to be parallel tests. This finding may be due either to the inadequacy of L_{vc} for this analysis, or to the fact that some items were misplaced within the *a priori* factors. After the experimental scales have been revised, this analysis should be repeated. On the other hand, the fairly substantial canonical correlation between various item categories justified combining scores into total or factor scores. Support of this tentative conclusion by further analysis may indicate that the traditional practice of combining items from rather diverse areas is acceptable.

4. *In the event that the answer to question three is affirmative, what are feasible ways of utilizing information from such disparate areas?*

Question three was answered negatively. Therefore, question four is no longer relevant.

Two additional benefits were derived from this study. The first of these involves the development of a number of efficient FORTRAN programs for multivariate analyses. These programs perform the following calculations: (1) Wilks' criteria test for parallel tests; (2) Wilks' test for equality of covariance matrices for two equal subgroups; (3) canonical correlations; and (4) McNemar's part-whole correlation. After these programs are revised to provide for variable formats, they should be helpful aids to researchers who are concerned with multivariate data.

The second benefit is related to the interpretation of canonical correlation. By examining the factor plots which are provided in the report, one is able to obtain an indication of the amount of shifting of variables to expect with various sizes of correlation.

Despite the rather encouraging results from this initial effort with the experimental instrument, much remains to be done before it will be available for distribution as a research tool. One of the first tasks will be to revise the instrument in light of the data obtained in this study. A number of items proved to be unsatisfactory, and it is almost certain that factors 11 and 12, "aesthetic expression" and "aesthetic appreciation" will be collapsed into a single aesthetic factor. Also, subjects failed to distinguish clearly between factors 8 and 10, "concrete, non-operative means" and "concrete, operative means". Once the revisions are made it will be necessary to study the factor structure of interests with samples which differ in sex, age, educational and ability level.

A pressing need is to determine the validity of the experimental scale. The high correlation with the SVIB indicates that the scale has concurrent validity. Yet, it is necessary to determine the ability of the scale to differentiate among a number of rather well defined criterion groups. Such studies are contemplated for the coming year.

REFERENCES

1. ANDERSON, T. W. *An Introduction to Multivariate Statistical Analysis*. New York: John Wiley, 1958.

2. BARNETT, G. J., HANDELSMAN, I., STEWART, L. H., & SUPER, D. E. The Occupational Level Scale as a Measure of Drive. *Psychol. Monogr.*, 1952, *66*, No. 10.

3. BARTLETT, M. S. Further Aspects of the Theory of Multiple Regression. *Proceedings of the Cambridge Philosophical Society*, 1938, *34*, 33-40.

4. BARTLETT, M. S. The Statistical Significance of Canonical Correlations. *Biometrika*, 1941, *32*, 29-38.

5. BERDIE, R. F. Factors Related to Vocational Interests. *Psychol. Bull.*, 1944, *41*, 137-157.

6. BOX, G. E. P. A General Distribution Theory for a Class of Likelihood Criteria. *Biometrika*, 1949, *36*, 317-346.

7. CARTER, H. D. Vocational Interests and Job Orientation. *Applied psychol. Monogr.*, 1944, *2*.

8. CLARK, K. E. *The Vocational Interests of Nonprofessional Men*. Minneapolis: Univ. of Minn. Press, 1961.

9. COOLEY, W. W. & LOHNES, P. R. *Multivariate Procedures for the Behavioral Sciences*. New York: John Wiley, 1962.

10. COTTLE, W. C. A Factorial Study of the Multiphasic, Strong, Kuder and Bell Inventories Using a Population of Adult Males. *Psychometrika*, 1950, *15*, 25-47.

11. CRONBACH, L. J. Further Evidence on Response Sets and Test Design. *Educ. psychol. Measmt.*, 1950, *10*, 3-31.

12. DARLEY, J. G. *Clinical Aspects and Interpretation of the Strong Vocational Interest Blank*. New York: Psychological Corporation, 1941.

13. DARLEY, J. G. & HAGENAH, THEDA. *Vocational Interest Measurement*. Minneapolis: Univ. of Minn. Press, 1955.

14. GARDNER, E. F. & THOMPSON, G. G. *Social Relations and Morale in Small Groups*. New York: Appleton-Century-Crofts, 1956.

15. GARRETSON, O. K. Relationships Between Expressed Preferences and Curricular Abilities of Ninth Grade Boys. *Teachers College Contr. Educ.*, 1930, No. 396.

16. GEE, HELEN H. & CLARK, K. E. *A Comparison of Empirical and Homogeneous Keys in Interest Measurement*. Minneapolis: Univ. of Minn. Dept. of Psychology, 1956, Tech. Rep.No. 6.

17. GORDON, L. V. Validities of the Forced-Choice and Questionnaire Methods of Personality Measurement. J. appl. Psychol., 1951, 35, 407-412.

18. GUILFORD, J. P., CHRISTENSEN, P. R., BOND, N. A., Jr. & SUTTON, M. A. A Factor Analysis Study of Human Interests. Psychol. Monogr., 1954, 68, No. 4.

19. GULLIKSEN, H. Theory of Mental Tests. New York: John Wiley, 1950.

20. HOTELLING, H. Relations Between Two Sets of Variates. Biometrika, 1936, 28, 321-377.

21. KRIEDT, P. H. Vocational Interests of Psychologists. J. appl. Psychol., 1949, 33, 482-488.

22. KULLBACK, S. Information Theory and Statistics. New York: John Wiley, 1959.

23. KUDER, G. F. The Kuder Preference Record. Chicago: Science Research Associates, 1956.

24. KUDER, G. F. A Comparative Study of Some Methods of Developing Occupational Keys. Educ. psychol. Measmt., 1957, 17, 105-114.

25. LAYTON, W. L. (ed.) The Strong Vocational Interest Blank: Research and Uses. Minneapolis: Univ. of Minn. Press, 1960.

26. MADDEN, D. E., MICHAEL, W. B., & RAINWATER, J. H. IBM 709 Fortran Program for Test Battery Analysis. Educ. psychol. Measmt., 1959, 19, 439-444.

27. MARRIOTT, F. H. C. Tests of Significance in Canonical Analysis. Biometrika, 1952, 39, 58-64.

28. NEWMAN, S. H., HOWELL, MARGARET A., & HARRIS, F. J. Forced Choice and Other Methods for Evaluating Professional Health Personnel. Psychol. Monogr., 1957, 71, No. 10.

29. OTIS, A. S. The Otis Self-administering Tests of Mental Ability. Yonkers: World Book, 1928.

30. PERRY, D. K. Forced-Choice vs. L-I-D Response Items in Vocational Interest Measurement. J. appl. Psychol., 1955, 39, 256-262.

31. ROSS, R. T. Optimum Orders for the Presentation of Pairs in the Method of Paired Comparisons. J. educ. Psychol., 1934, 25, 375-382.

32. STEWART, L. H. Modes of Response on the Strong Blank and Selected Personality Variables. J. counsel. Psychol., 1960, 7, 127-131.

33. STRONG, E. K., Jr. *Change of Interests with Age*. Stanford: Stanford Univ. Press, 1931.

34. STRONG, E. K., Jr. *The Strong Vocational Interest Blank*. Stanford: Stanford Univ. Press, 1938.

35. STRONG, E. K., Jr. *Vocational Interests of Men and Women*. Stanford: Stanford Univ. Press, 1943.

36. STRONG, E. K., Jr. *Vocational Interests 18 Years After College*. Minneapolis: Univ. of Minn. Press, 1955.

37. SUPER, D. E. *Avocational Interest Patterns*. Stanford: Stanford Univ. Press, 1940.

38. SUPER, D. E. Strong's Vocational Interests of Men and Women: A Special Review. *Psychol. Bull*., 1945, *42*, 359-370.

39. SUPER, D. E. Vocational Interests and Vocational Choice. *Educ. psychol. Measmt*., 1947, *7*, 375-383.

40. SUPER, D. E. The Measurement of Interests. *J. counsel. Psychol*., 1954, *1*, 168-172.

41. SUPER, D. E. & CRITES, J. O. *Appraising Vocational Fitness*. New York: Harper, 1962.

42. THURSTONE, L. L. A Law of Comparative Judgment. *Psychol. Rev*., 1927, *34*, 273-286.

43. THURSTONE, L. L. A Multiple Factor Study of Vocational Interests. *Personnel J*., 1931, *10*, 198-205.

44. THURSTONE, L. L. & THURSTONE, THELMA G. *Tests of Primary Mental Abilities*. Chicago: Science Research Associates, 1947.

45. TORGERSON, W. S. *Theory and Methods of Scaling*. John Wiley, 1958.

46. TRAVERS, R. M. W. A Critical Review of the Validity and Rationale of the Forced-Choice Technique. *Psychol. Bull*., 1951, *48*, 62-70.

47. U.S. EMPLOYMENT SERVICES. *Worker Trait Requirements for 4,000 Jobs*. Washington, D.C.: Government Printing Office, Undated.

48. WILKS, S. S. Certain Generalizations in the Analysis of Variance. *Biometrika*, 1932, *24*, 471-494.

49. WILKS, S. S. Sample Criteria for Testing Equality of Means, Equality of Variances, and Equality of Covariances in a Normal Multivariate Distribution. *Ann. Math. Stat*., 1946, *17*, 257-281.

APPENDIX A

DESCRIPTION OF PROJECT STUDY ACCOMPANYING ORIGINAL CONTRACT APPLICATION

Proj. No. 1493

APPENDIX A

Project Title: Application of Multidimensional and Scale Analysis to Interest Measurement

Submitted by: University of California

Address: Berkeley 4, California

Telephone: THornwall 5-6000, Ext. 3495
Area Code 415

Initiated by: Royce R. Ronning
Walter R. Stellwagen
Lawrence H. Stewart

Fiscal Officer: L. K. Barnes
Accounting Office
402 Sproul Hall
University of California
Berkeley 4, California
THornwall 5-6000, Ext. 2074
Area Code 415

Transmitted by:

Date: August 21, 1961

Revised: January 15, 1962

Application of Multidimensional and Scale Analysis to Interest Measurement

I. Problem

A common practice in the measurement of non-cognitive processes such as interests, values and personality characteristics, is the combination of a group of heterogeneous items into a scale on the basis of empirically or rationally developed keys. Examples of such scales are the subscales of the Minnesota Multiphasic Personality Inventory (MMPI), the Kuder Preference Record (KPR), the Strong Vocational Interest Blank (SVIB), etc. While these scales have some internal consistency, the factor structure of the items has not been considered explicitly in scale development. On the KPR, for example, a wide variety of items with a common referent such as science simply are added. No attention is given to possible differences in factor structure between different item categories such as hobbies, job titles, and characteristics of people.

A second common practice in measurement is the use of arbitrary integer weights (most commonly 0 and 1) for individual items. Recently, however, Gardner and Thompson (6) successfully have applied sophisticated scaling techniques to the measurement of social relations and values. The application of such techniques, if successful, leads to measurement on an interval scale. This is of great significance because it represents one of the few successful ateempts at interval scaling in the measurement of non-cognitive factors. In addition, the use of a reference population unique to each individual gives explicit consideration to the frame of reference within which an individual responds to an item. An example of an instrument which imposes an arbitrary frame of reference is the KPR. Thus it is possible for a subject to obtain a high score on one scale, when in fact he may dislike all the items on that scale if at the same time he dislikes items on a second scale to an even greater degree.

While the above considerations apply to many fields of measurement, it is crucial that the area of vocational interest scaling (largely ignored by measurement specialists) be given special attention at this time. This is reflected in the fact that the most commonly used interest scales, viz. the SVIB and KPR have not been revised in over twenty years. Thus it seems appropriate that the application of recent technical developments to measures of interests be investigated, particularly in view of the widespread use of these measures in counseling and guidance.

Specifically, the tasks set forth within this proposal are to:

1) Examine the implicit assumptions underlying various techniques of combining heterogeneous interest items into a "homogeneous" scale.
2) Apply scaling techniques heretofore unused in the interest field to the development of selected scales of educational-vocational interests.
3) Explore, within the context of homogeneous groups of items, aspects of the structure of educational-vocational interests. Recent developments in data processing utilizing high speed computers make such an exploration feasible.

II. Objectives

1) To develop a number of scales of educational-vocational interests by use of a fractionation technique similar to that employed by Gardner and Thompson (6).

    Each scale will be composed of items from ten categories, each category common to all scales. Examples of possible categories are: amusements, occupations, school subjects, etc.

2) To study selected properties of the scales.

3) To compare scales developed by the fractionation technique with scales developed using the law of comparative judgment (12).

In the analysis of the scales the following questions will be explored:

A. Will the fractionation procedures yield reliable and stable results?
   1) Is the factor structure of the scales stable over a period of time (test-retest)?
   2) Is the factor structure similar for two independent samples (cross-validation)?

B. Is the factor structure obtained from scales developed by a fractionation technique similar to the factor structure obtained from scales developed by a paired-comparison technique?

C. Does the factor structure of the scales within one item category such as hobbies differ from the factor structure of the scales within another item category such as job titles?

D. In the event that the answer to question C is in the affirmative, what are feasible ways of utilizing information from such disparate areas?

III. Other Related Research

The literature in the field of interest measurement is voluminous, as indicated by the many excellent reviews of research on the SVIB (5, 1, 4, 10, 8, and 9). Although literature on interest scales other than the SVIB is also voluminous, comprehensive reviews are not available. Since practically none of the past research in interest measurement is related closely to this proposal, such research will not be reviewed here.

The single interest study most specifically related to this proposal is that carried out by Cottle (3). An adaptation of his findings by the U.S.E.S. (13) identifies the factors around which the scales in this proposal initially will be developed.

The scaling technique to be used in the proposed study is patterned after that described by Gardner and Thompson (6). The technique is being used currently by Gardner and Thompson in a study of value scaling supported by a grant from the U. S. Office of Education.

The statistical techniques to be used in analysis of the data are described in Wilks (14) and Cochran (2).

INTEREST AREAS OR FACTORS*

ITEM CATEGORY	Things and Objects	Business Contact with People	Routine, Concrete, Organized Activities	Social Welfare or Dealing with People and Language in Social Situations	Activities Resulting in Prestige or the Esteem of Others	People and the Communication of Ideas	Scientific and Technical	Abstract and Creative Activities	Processes, Machines, and Techniques	Tangible, Productive Activities
HOBBIES										
TOOLS OF THE TRADE										
JOB TITLES										
To Ten Categories										

Figure 1 Test Format

*Factors taken from Cottle and modified by U.S.E.S.

IV. Procedure

Phase I: Instrument Construction

As the instrument will have a new format, a detailed description is in order. Several categories within which interests may be expected to vary will be chosen.[1] Possible examples of such categories are hobbies, characteristics of people, and tools involved in various types of work. Items within each category will represent each of the ten interest areas found by Cottle and modified by the U.S.E.S. (see figure 1, page 5). Symbolically, we may thus represent the test format by a matrix $Y = (y_{ij})$: $i, j = 1, 2 \ldots, 10$ where y_{ij} is the item in category i which refers to interest area j. The subject will be asked to scale items in each item category by a fractionation method similar to that used by Gardner and Thompson.

Consider the item category of hobbies as a paradigm. The subject will be shown a normal curve pictograph and instructed to think of the category of all hobbies with which he is acquainted. He is to consider such hobbies as being normally distributed in terms of his preference. He will then be instructed to consider figure 2 and choose from among all the hobbies of which he has heard the one he most prefers and enter its name in the box under "most". He will then choose the hobby least preferred and enter it in the box under "least". He will then be asked to select, from the category of all

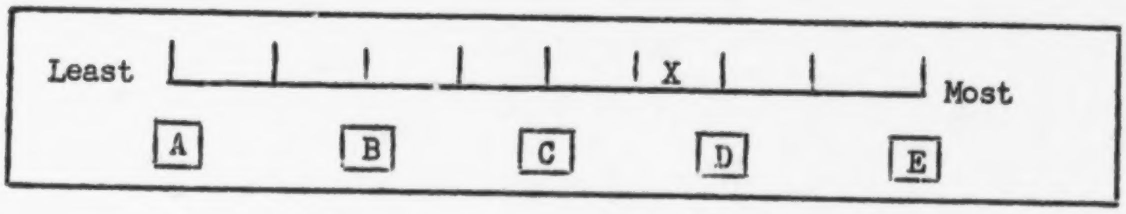


Figure 2 Answer Sheet Format

---

[1] Practical considerations may affect the number of categories. The writers hope to use approximately ten categories. In the remainder of this application it shall be assumed that there are exactly ten categories.

hobbies, a hobby about halfway between the hobbies he has entered in the boxes "most" and "least" and enter it in the middle box. Continuing in this way he will select hobbies, A, B, C, D, and E to enter in each box. This constitutes the first phase of the scaling; namely, anchoring the continuum of hobbies with selected hobbies from an outside "reference population". Relative to this continuum, the ten hobby items will be scaled by a fractionation technique. That is, for each hobby item the subject will be asked, "Is the hobby between A and C or E and C?" (S chooses E and C.) "Is the hobby between E and D or C and D?" (S chooses C and D.) "Is the hobby closer to C or D?" (S chooses D.) The hobby is then entered at X (see figure 2).

This method will yield a scale value for each item (representing an interest area) along a continuum representing each item category. Each subject will thus be represented by a 10 x 10 matrix $X_s = (x_{ijs})$: $i, j = 1, 2, . . ., 10$ where x_{ijs} is the scale value for subject s on item y_{ij} relative to the continuum representing item category i. It is the dimensional properties of these hypothetical continua which are of primary interest in this study.

Whenever possible items will be obtained from the SVIB and the KPR. In the event that additional items are required, they will be constructed.

During Phase I, we plan to hold several conferences with experts in the fields of scaling techniques and interest measurement. These conferences will be concerned primarily with criticizing the experimental instrument and the data collection procedures.

Phase II: Data Collection

A group of at least 200 college freshmen will be selected. The primary reasons for selecting college freshmen are the relatively large investment of subject's time in collecting data and the desirability of maintaining contact with the S's over a period of time. The processes under investigation, i.e., the factor structure of interests, should not be affected greatly by the restricted nature of the sample. The group will be divided randomly into two equal samples for cross validation purposes. For purposes of investigating reliability, each subject will be administered the experimental instrument twice, (with a five-week interval). All S's will also take the SVIB and the KPR. The last two instruments will be administered primarily for purposes of motivating the subjects (the scores will be made available to the subject's counselor). In addition, it may be of interest to study relationships between the scales developed by the fractionation technique and selected scales from the SVIB and KPR. The SVIB and KPR were selected in lieu of other interest inventories because they are recognized as the two best measures of interests currently available.

Within each item category the ten items will be arranged into the forty-five possible pairs, and paired comparisons will be made by an additional group of approximately fifty college freshmen, who also will take the experimental instrument. It is envisioned that each of the 450 pairs will be presented ten times to each subject. This will permit examination of the assumptions underlying the fractionation technique.

In summary, let p be the validation sample; $p = 1, 2$; let k be the subject within a group: $k = 1, 2, . . ., N$. For each subject, kp, the following data will be collected:

1) Two matrices X_{kp} of scale values on the experimental instrument,
2) A set of scores on the SVIB,
3) A set of scores on the KPR.

A third group will make paired comparisons of item pairs and take the experimental instrument.

As far as possible, all data will be collected on mark sensed IBM cards in order that data processing may be expedited. It is planned that all scoring and data processing will be performed by an IBM 704 digital computer. The reasons for this are speed, economy, and accuracy since over 100,000 separate scores will be obtained.

Phase III: Analysis

Overview

A. By Wilks test for equality of variance-covariance matrices, compare two validation samples on each item category.

B. By canonical correlation, compute test-retest reliability.

C. By canonical correlation, compare experimental scores with results with paired comparison scaling.

D. By canonical correlation, compare item categories.

E. Perform analysis related to combining scales (if indicated).

F. Study relationships between experimental scales and the SVIB and KPR.

For each validation sample ten variance-covariance matrices will be generated -- one for each of the ten item categories. These matrices will be compared pairwise by Wilks' procedure (14). Wilks' test is a test of the equality of variance-covariance matrices, a sufficient and in all likelihood necessary condition for equivalence of factor structure. If the samples are found to be different on any scales, a more intensive analysis of the samples will be undertaken. As a possible example, factor analyses can be performed to determine the nature of the differences in structure between the two samples. If the two validation samples do not differ they will be combined for all further analyses. Test-retest reliability will be computed for each item category by canonical correlation, see Thompson (11).

Canonical correlations will be computed between item categories in order to evaluate the differences or similarities. If necessary, further analyses will be performed to shed light on any differences and to aid in formulating methods of combining scale values from disparate item categories. As appropriate, factory analyses, canonical correlation, and other multivariate techniques will be utilized to assess the relationships between the combined scales on the experimental instrument and the SVIB and KPR.

The paired comparisons will be analyzed by conventional methods leading to a score matrix Z_s for each of the subjects in the group. Correlation matrices R_s will be computed from these data and from the data from the experimental instrument. Canonical correlations between X_s and Z_s will be computed in order to compare the two scaling methods.

Expected end products are a monograph and several papers. The findings should add materially to knowledge of scaling techniques and should provide a basis for the development of improved measures of educational-vocational interests.

V. Personnel

Lawrence H. Stewart - Associate Professor of Education (Counseling Psychology)
Publications in the area of interest measurement.

1. ____The relationship of certain social factors to occupational level as measured by the Strong Vocational Interest Blank, 1950, Unpublished doctoral dissertation.
2. ____With Barnett, G. J., Handelman, I., and Super D. E. The occupational level scale as a measure of drive. Psychol. Monogr., 1952, 66.
3. ____With Barnett, G. J. and Super D. E. Level of occupational interest: deadweight or dynamics? Educ. Psychol. Measmt., 1953, 13, 193-208.
4. ____With Roberts, J. P. The relationship of Kuder profiles to remaining in a teachers college and to occupational choice. Educ. Psychol. Measmt., 1955, 15, 416-421.
5. ____Mother-son identification and vocational interests. Genetic Psychol. Monogr., 1959, 60, 31-63.
6. ____Socio-economic status and children's occupational attitudes and interests. J. Genetic Psychol., 1959, 95, 111-136.
7. ____Interest patterns of high-ability students, J. Counsel. Psychol., 1959, 6,132-139
8. ____"Occupational level" a scale of children's interests, Educ. Psychol. Measmt., 19, 1959, 401-410.
9. ____The non-occupation keys on the Strong Blank and amount of education. Calif. J. Educ. Research. A study of persistence in junior college and university male students
10. ____Modes of responses on Strong Blank and selected personality variables. J. Counsel. Psychol., 7, 1960, 127-131.

Walter Stellwagen - Assistant Professor of Education

Has been engaged in research in the area of multidimensional analysis, with specific emphasis on Banach space models. A general Banach space model for multivariate methods is in preparation.

Royce R. Ronning - Assistant Professor of Education (Educational Psychology)
Publications relevant to multivariate analysis:

1. ____With Bartlett, C. J., and Hurst, J. G. A study of classroom evaluation techniques with special reference to application of knowledge. J. Educ. Psychol., 51, 1960, 152-158.

2. ____With Hurst, J. G. and Bartlett, C. J. An approach to evaluation in educational psychology courses and its instrumentation. Educ. Psychol. Measmt., 1961, 21, 445-456.

3. ____With Horrocks, J. E. A method of estimating the effectiveness of groups in a "group" teaching situation. Educ. Psychol. Measmt., 1961, 21, 331-348.

VI. Facilities

Special facilities and advantages:

A. IBM 704 high speed digital computer.

B. Outstanding library facilities.

C. Consultants.

The University of California has one of the best statistical departments in the United States. Persons such as J. Neyman, D. Blackwell, H. Scheffe and J. Hodges are available for consultation. Also personnel from the Department of Psychology and the various scholarly research centers such as the Institute of Personality Assessment and Research, Institute of Human Development, and the Survey Research Center can aid in the solution of any special problems arising in connection with the study.

Other scholarly centers, such as Stanford University and The Center for Advanced Studies in the Behavioral Sciences, are located within a short distance from the Berkeley campus, thus greatly increasing the potential supply of highly trained consultants available for the project.

VII. Duration

Total amount of time required - one year.

Beginning: February 1, 1962.

Ending: January 31, 1963.

VIII. Other Information

A. The only support available from other sources is the amount indicated under University matching funds.

B. This proposal has not been submitted to any other agency.

C. This is not an extension of a previous project supported by the Office of Education.

D. This project was submitted previously (April, 1961) to the Office of Education. #1347.

References

1. Carter, H. D. - Vocational interests and job orientation. *Appl. Psychol. Monogr.*, 1944, #2.

2. Cochran, W. G. - The comparison of different scales of measurement for experimental results. *The Annals of Math Stat.*, 1943, *14*, 205-216.

3. Cottle, W. C. - A factorial study of the Multiphasic, Strong, Kuder, and Bell Inventories using a population of adult males. *Psychometrica*, 1950, *15*, 25-47.

4. Darley, J. G. and Hagenah - *Vocational Interest Measurement*, Minneapolis; Univ. Minn. Press, 1935.

5. Fryer, D. - *The Measurement of Interests*, New York: Henry Holt, 1931.

6. Gardner, E. F. and Thompson, G. C. - *Social Relations and Morale in Small Groups*, New York: Appleton Century Crofts, 1956.

7. Rasch, George - *Studies in Mathematical Psychology I*, Copenhagen, The Danish Institute for Educational Research, 1960.

8. Strong, E. K., Jr. - *Vocational Interest of Men and Women*, Stanford Univ. Press, 1943.

9. Strong, E. K., Jr. - *Vocational Interests 18 Years After College*, Univ. Minn. Press, 1955.

10. Super, D. E. - *Appraising Vocational Fitness*, New York: Harper, 1944.

11. Thomson, G. H. - Weighting for battery reliability and prediction, *Brit. J. of Psychol., Stat. Section*, *4*, 1940, 357.

12. Torgerson, W. S. - *Theories and Methods of Scaling*, Wiley, 1958.

13. U. S. Employment Service - *Worker Trait Requirements for 4,000 Jobs*, U. S. Dept. of Labor, Bureau of Employment Security.

14. Wilks, S. S. - Sample criteria for testing equality of means, equality of variances, and equality of covariances in a normal multivariate distribution: *The Annals Math. Stat.*, 1946, 17, 257-281.

ABSTRACT

Application of Multidimensional and Scale Analysis to Interest Measurement

Objectives

The primary objective of the proposed study is to apply scaling techniques to the measurement of interests. In addition, we wish to examine the factor structures of interest areas within homogeneous item categories and to compare differences in such structures between item categories. Also of interest is the relationship between an instrument based upon the above with the SVIB and the KPR.

Procedure

An experimental instrument utilizing a modification of the fractionation procedure devised by Gardner and Thompson[1] will be constructed. This instrument, the SVIB, and the KPR will be administered to a group of college students. In addition, the experimental instrument and a modified instrument utilizing paired comparison scaling will be administered to a separate group of students. On the basis of these data the instrument will be assessed for reliability, replicability of results (cross-validation), and similarity of results to those obtained by more conventional scaling procedures. In addition, the factor structure of interests, as manifested within homogeneous item categories, will be assessed and comparisons made between such item categories. The relationships between the experimental instrument and the SVIB and KPR will be examined.

The primary tools utilized in the above analyses will be: canonical correlation, factor analysis, and multivariate tests of significance.

---

[1] Gardner, E. F. and Thompson, G. G., Social Relations and Morale in Small Groups.

Royce R. Ronning
Walter R. Stellwagen
Lawrence H. Stewart

APPENDIX B

EXPERIMENTAL INSTRUMENT

Form II

APPENDIX B

EXPERIMENTAL INSTRUMENT FORM II

(Copyright 1962)

Today you are going to take a different kind of test. You will be asked to decide how much you like or dislike certain things. These things will be described by a number of brief paragraphs. The paragraphs will instruct you to think of the X's in the picture as if they were certain jobs, ideas, or things one might do. You will notice that in the middle of this picture there are a great many X's. This is to show you that there will be many things to choose from in this middle group. There is only one X at each end of the picture. This tells you that there are few things that you very much like or dislike.

You will be asked to write in the boxes at the top of each page your own choices of things you like very much; things you dislike very much; things that seem about medium to you; and two other choices that fall in between the middle and the top, and the middle and the bottom. These boxes are labeled "Halfway Between". You will be given the subject about which you will write in every case. Then you will turn the cover page and compare, in terms of your preference, the printed items --numbered 1 through 12-- with what you have written in the boxes at the top of the page. Do not turn the the cover page until you have filled in all the boxes with your own choices.

Now turn the page and we will do Area I together.

AREA I

Think of the X's in the picture on the opposite page as showing all possible characteristics of jobs which people might find pleasant or unpleasant. An example of such a characteristic might be "pleasant co-workers". Do not consider salary or level of training which might be implied and do not use job titles.

a) From all the possible job characteristics of which one can think, write in the box labeled "Like Very Much" one characteristic in which you would find a great deal of satisfaction.

b) Now from all these job characteristics, write in the box labeled "Dislike Very Much" one characteristic which you would find very displeasing.

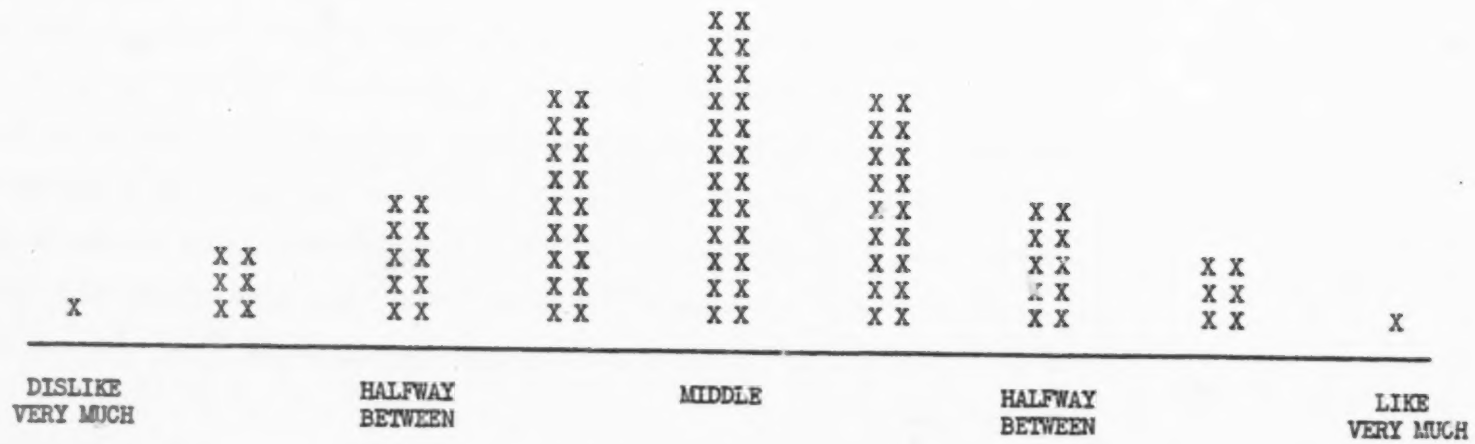
c) Among all the job characteristics of which you can think, there are some which are about medium or average in pleasantness. The characteristic you write in the box labeled "Middle" could be any one of a number of characteristics. (See all the X's in the middle of the picture.) Write the name of any one of these characteristics of average pleasantness in the box which is above the word "Middle".

d) Now look at the left half of the picture. Some of the characteristics are better than the ones you dislike very much, but not as good as the medium characteristic in the middle of the picture. Some of these characteristics are about halfway between the one you dislike very much and the middle one. As you can see by the X's in the picture, there are quite a few of the "Halfway Between" characteristics. None of them is next to the "Dislike Very Much" box; for, as you can see, there are characteristics between the "Dislike Very Much" box and the "Halfway Between" box. Write the name of any one of these halfway between characteristics in the "Halfway Between" box on the left.

e) Now look at the right half of the picture. Some of the job characteristics are more pleasant than any of the medium ones; but, of course, not as pleasant as the ones you like very much. Some of these characteristics are about halfway between the ones you like very much and a middle characteristic. As you can see by the X's in the picture, there are quite a few of the "Halfway Between" characteristics. None of them is next to the characteristic in the "Like Very Much" box; for, as you can see, there are characteristics between the "Like Very Much" box and the "Halfway Between" box. Write the name of any one of these halfway between characteristics in the "Halfway Between" box on the right.

DO NOT TURN COVER SHEET UNTIL YOU

HAVE FILLED IN THE BOXES



COVER SHEET

Now look at the items on the opposite page. Your task will be to compare each of these twelve items with the ones you have just placed in the boxes. Thus, for example, you take Item 1 —"Opportunity to write—to express my thoughts"— and decide, in terms of your personal preference which half of the distribution it belongs in; that is, does it fall between the middle box and the box at the extreme right; or does it fall between the middle box and the box at the extreme left. Then decide which quarter of the distribution it falls in; that is, does it fall between the "Halfway Between" box and the "Middle" box; or the "Halfway Between" box and the end box. Having decided in which quarter the item falls, in terms of your preference; show which box it falls closest to by putting an X at a point on the line opposite the item. This X will show to which box the item is closest.

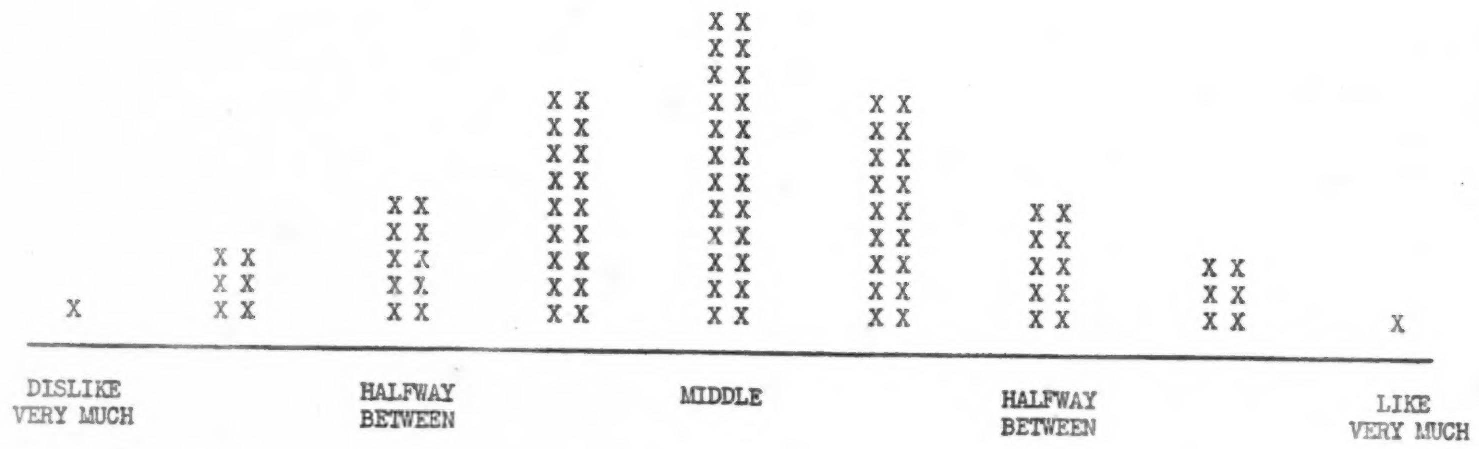
If the item is the same as your entry in one of the boxes, write "same" at the appropriate point on the line.

AREA I Think of the X's in the picture as showing all possible characteristics of jobs which people might find pleasant or unpleasant. An example of such a characteristic might be "pleasant co-workers". Do not consider salary or level of training which might be implied, and do not use job titles.

ITEMS	Less than Dislike Very Much	DISLIKE VERY MUCH ☐		HALFWAY BETWEEN ☐		MIDDLE ☐		HALFWAY BETWEEN ☐		LIKE VERY MUCH ☐	Better than Like Very Much
1. Opportunity to write-to express my thoughts	___		___/___		___/___		___/___		___/___		___
2. Opportunity to work with equipment	___		___/___		___/___		___/___		___/___		___
3. Opportunity to influence people or manage others	___		___/___		___/___		___/___		___/___		___
4. Opportunity to enjoy the beauty around me	___		___/___		___/___		___/___		___/___		___
5. To associate with important or key people	___		___/___		___/___		___/___		___/___		___
6. Opportunity to devise concrete methods for attaining some goal	___		___/___		___/___		___/___		___/___		___
7. Opportunity for excitement and adventure	___		___/___		___/___		___/___		___/___		___
8. Opportunity to use my artistic ability	___		___/___		___/___		___/___		___/___		___
9. Opportunity to think-to work with ideas	___		___/___		___/___		___/___		___/___		___
10. Opportunity to help others	___		___/___		___/___		___/___		___/___		___
11. Opportunity to be in responsible position-a leader	___		___/___		___/___		___/___		___/___		___
12. Opportunity to work in orderly, systematic manner	___		___/___		___/___		___/___		___/___		___

DO NOT TURN COVER SHEET UNTIL YOU

HAVE FILLED IN THE BOXES



COVER SHEET

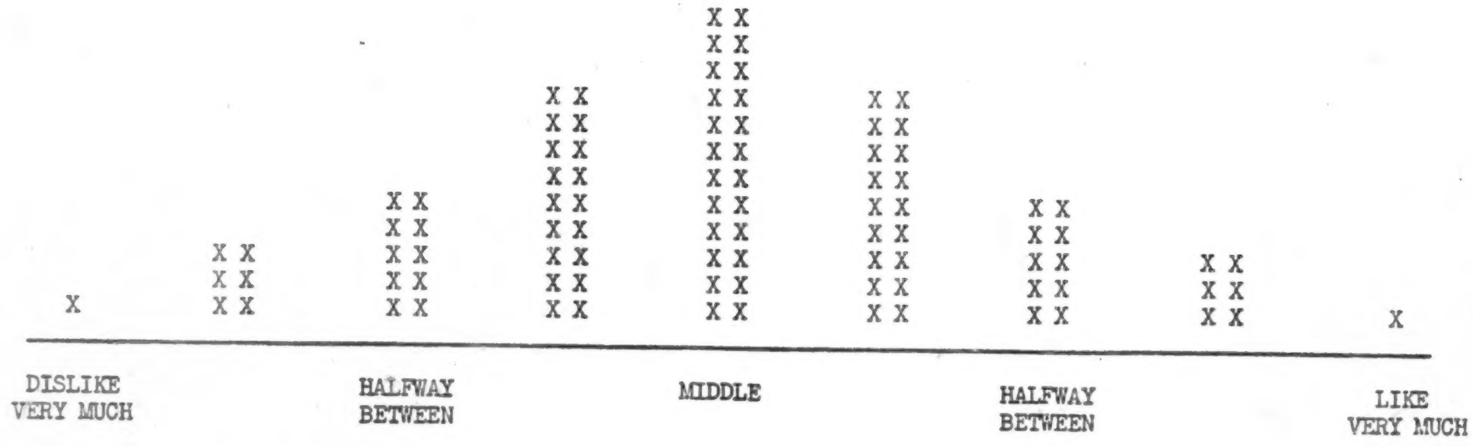
AREA II Think of the X's as representing all possible inscriptions (descriptive phrases underneath photographs) which might be printed under a student's name in a yearbook. An example of such an inscription might be "most popular". Fill in the boxes below with your choices from these inscriptions.

ITEMS	DISLIKE VERY MUCH	HALFWAY BETWEEN	MIDDLE	HALFWAY BETWEEN	LIKE VERY MUCH
1. He'll go far in the arts					
2. BMOC — Big man on campus					
3. Egghead — a true scholar					
4. A born leader					
5. Highbrow—appreciates the finer things in life					
6. Systematic, dependable, businesslike					
7. The pen is mightier than the sword					
8. If he can't fix it, throw it away					
9. Seeking new worlds to conquer					
10. Genius at running equipment					
11. A friend indeed					
12. The world is his oyster					

Less than Dislike Very Much

Better than Like Very Much

DO NOT TURN COVER SHEET UNTIL YOU
HAVE FILLED IN THE BOXES



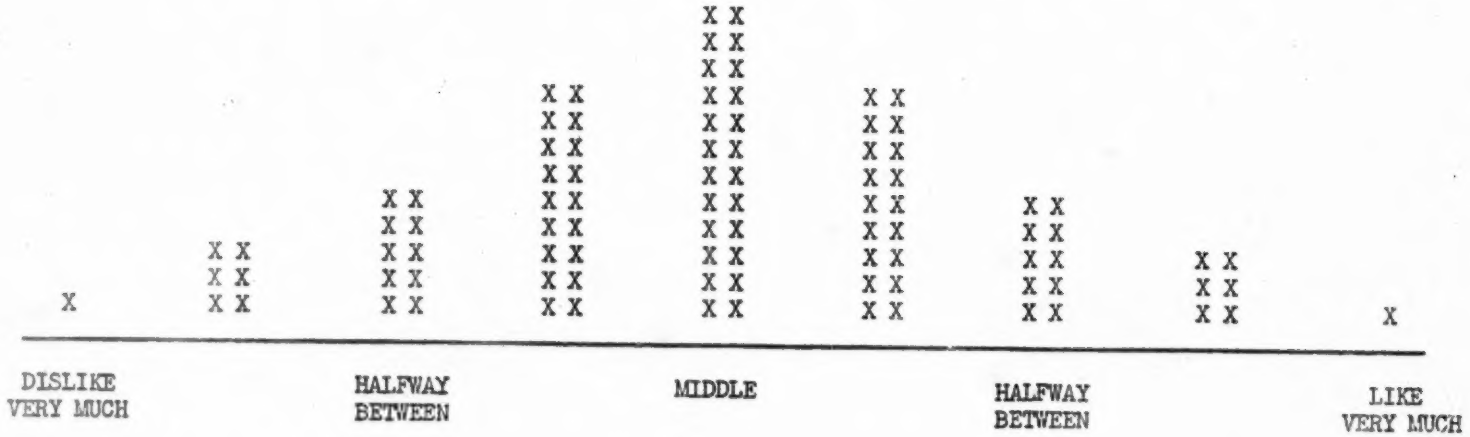
COVER SHEET

AREA III Imagine that you are in your home town and that due to unexpected circumstances, you have a full day of free time that you can use in any way that you wish. Think of the X's as representing all possible activities which one might carry out during such a day. An example of something you might do would be "just relax". Fill in the boxes below with your choices from these activities.

ITEMS	Less than Dislike Very Much	DISLIKE VERY MUCH	HALFWAY BETWEEN	MIDDLE	HALFWAY BETWEEN	LIKE VERY MUCH	Better than Like Very Much
1. Arrange a stamp collection							
2. Collect my thoughts about some new scientific or philosophical theory							
3. Design and build a hi-fi unit							
4. Work with group of youngsters at the Boys Club							
5. Write a short story or article for school magazine							
6. Try out a new power tool							
7. Read society page in local paper							
8. Explore a little-known section of a nearby city							
9. Plan meeting of committee of which you are chairman							
10. Urge friends to join you in some activity							
11. Indulge in some creative activity such as painting							
12. Listen to new record album							

DO NOT TURN COVER SHEET UNTIL YOU

HAVE FILLED IN THE BOXES



COVER SHEET

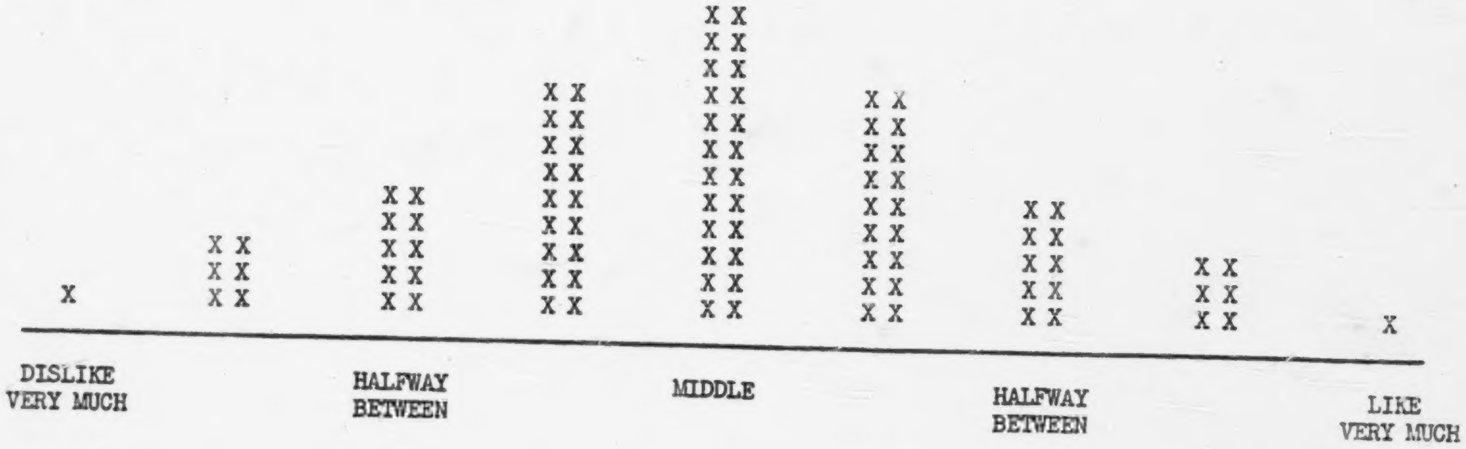
B-4

AREA IV Imagine that your school is planning a series of illustrated lectures which must be attended by all students. Imagine further that you are a member of a committee which will decide on the topics of the lectures covered in the series. Think of the X's as representing all lecture topics that might be included in this series. An example of such a topic might be "Areas of Political Unrest". Fill in the boxes below with your choices from these topics.

ITEMS	Less than Dislike Very Much	☐ DISLIKE VERY MUCH	☐ HALFWAY BETWEEN	☐ MIDDLE	☐ HALFWAY BETWEEN	☐ LIKE VERY MUCH	Better than Like Very Much
1. Lives of important people							
2. The Operating Procedure in an Atomic Reactor							
3. How to Write a Short Story—The Writer's Craft							
4. Taming the Wilderness							
5. The Responsibilities of Leadership							
6. Improving Your Personality							
7. Using Your Time Effectively							
8. Great Ideas of Our Time							
9. Humane Care for Animals							
10. Peaceful Uses of Atomic Energy							
11. Developing your Artistic Skills							
12. Appreciating Modern Art							

DO NOT TURN COVER SHEET UNTIL YOU

HAVE FILLED IN THE BOXES



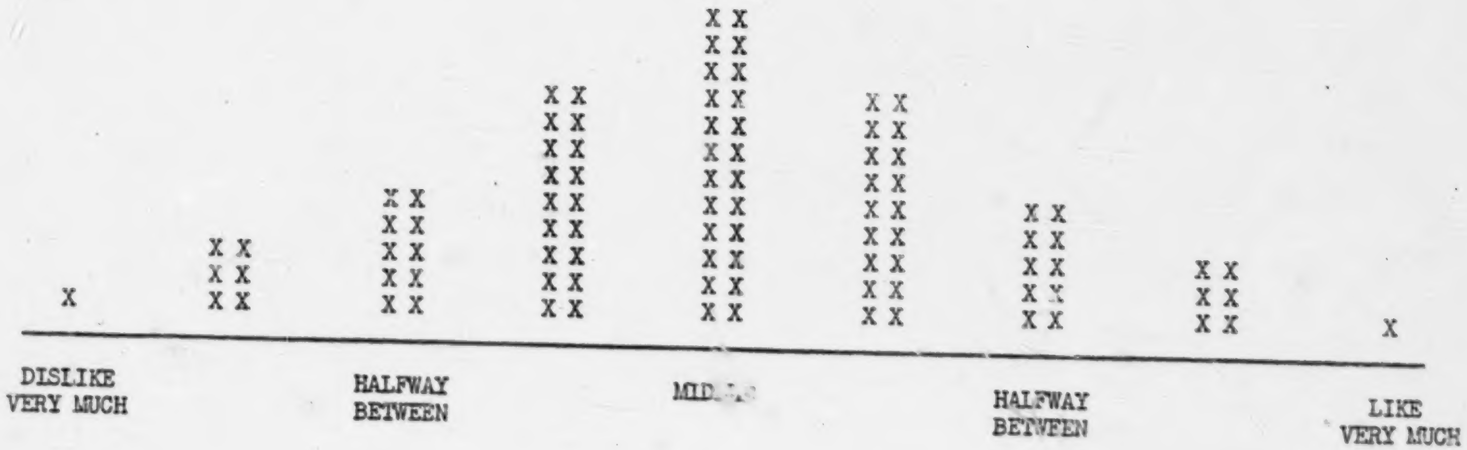
COVER SHEET

AREA V Imagine that the X's represent phrases or terms describing all characteristics which people might desire in close associates or friends. An example of such a phrase might be "sense of humor". Fill in the boxes below with your choices from these phrases.

ITEMS	Less than Dislike Very Much	DISLIKE VERY MUCH	HALFWAY BETWEEN	MIDDLE	HALFWAY BETWEEN	LIKE VERY MUCH	Better than Like Very Much
1. People who can make things work							
2. Ingenious people--those who can make practical application of ideas							
3. Fluent, articulate people--people who can use words							
4. Systematic, well-organized, prompt people							
5. Sympathetic people							
6. Leaders							
7. Talented people							
8. Famous people							
9. People with keen minds							
10. Adventurous and daring people							
11. Dominant, persuasive people							
12. Cultured people							

DO NOT TURN COVER SHEET UNTIL YOU

HAVE FILLED IN THE BOXES



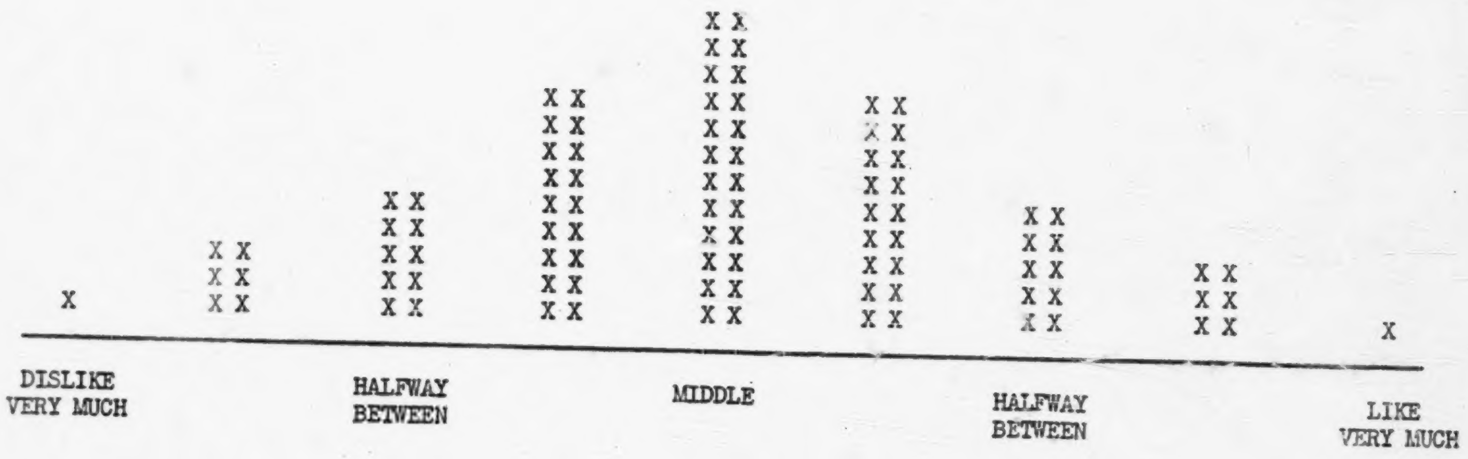
COVER SHEET

AREA VI Imagine that you have been given the assignment of preparing a review of a non-fiction book, and that you may choose a non-fiction book on any topic you like. Suppose that the X's represent all possible topics of non-fiction books. An example of such a topic might be "political science". Fill in the boxes below with your choices from these books. Use either general topics or book titles.

ITEMS	Less than Dislike very much	DISLIKE VERY MUCH	HALFWAY BETWEEN	MIDDLE	HALFWAY BETWEEN	LIKE VERY MUCH	Better than Like Very Much
1. Books about successful executives							
2. Books on self-expression (speaking)							
3. Books on discoveries which have helped mankind							
4. Lives of great explorers							
5. Books on operation of equipment and apparatus							
6. Books on theoretical and abstract topics							
7. Books on how to make a good impression--how to be persuasive							
8. Books on etiquette							
9. Books on sketching or painting techniques							
10. Books on methods of cost accounting							
11. Collections of famous works of art							
12. Books on how to construct equipment or how to build objects							

DO NOT TURN COVER SHEET UNTIL YOU

HAVE FILLED IN THE BOXES



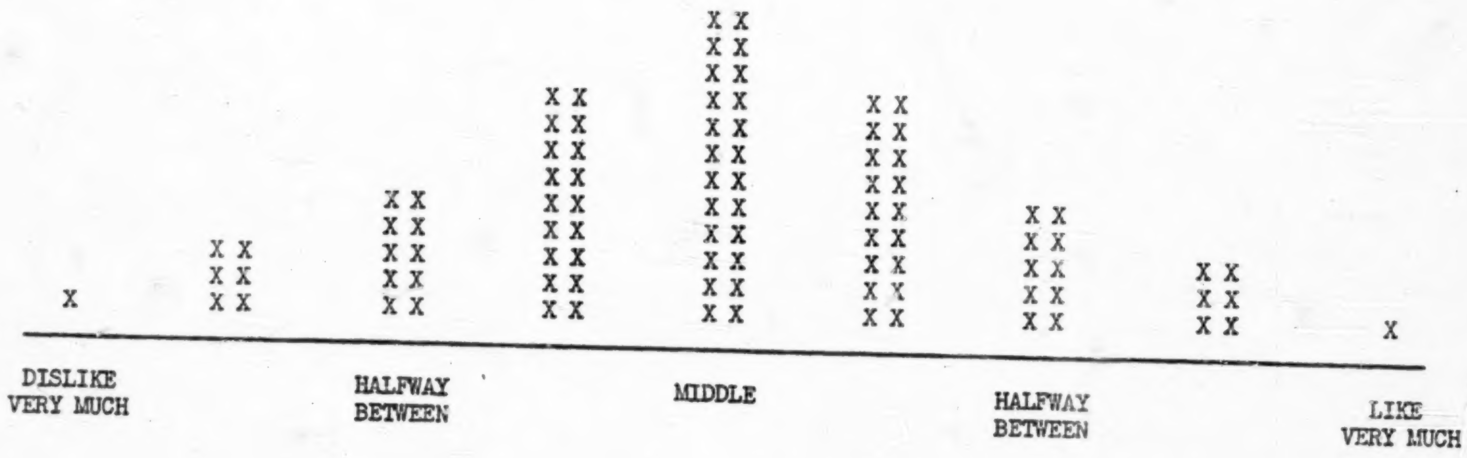
COVER SHEET

AREA VII Think of the X's as representing all possible areas of study which might be included in a college or university curriculum. An example of such an area would be "history". Assume that you have enough ability to do successful work in any area. Fill in the boxes below with your choices from these areas of study.

ITEMS	Less than Dislike Very Much	DISLIKE VERY MUCH	HALFWAY BETWEEN	MIDDLE	HALFWAY BETWEEN	LIKE VERY MUCH	Better than Like Very Much
1. Advertising, salesmanship							
2. Foreign service--diplomacy							
3. Industrial technology							
4. Organic chemistry							
5. Social welfare							
6. Creative writing							
7. Accounting							
8. Personnel Administration							
9. Aesthetics--music or art appreciation							
10. Physical education and sports							
11. Creative art and/or music							
12. Philosophy or mathematics							

__DO__ __NOT__ __TURN__ __COVER__ __SHEET__ __UNTIL__ __YOU__

__HAVE__ __FILLED__ __IN__ __THE__ __BOXES__



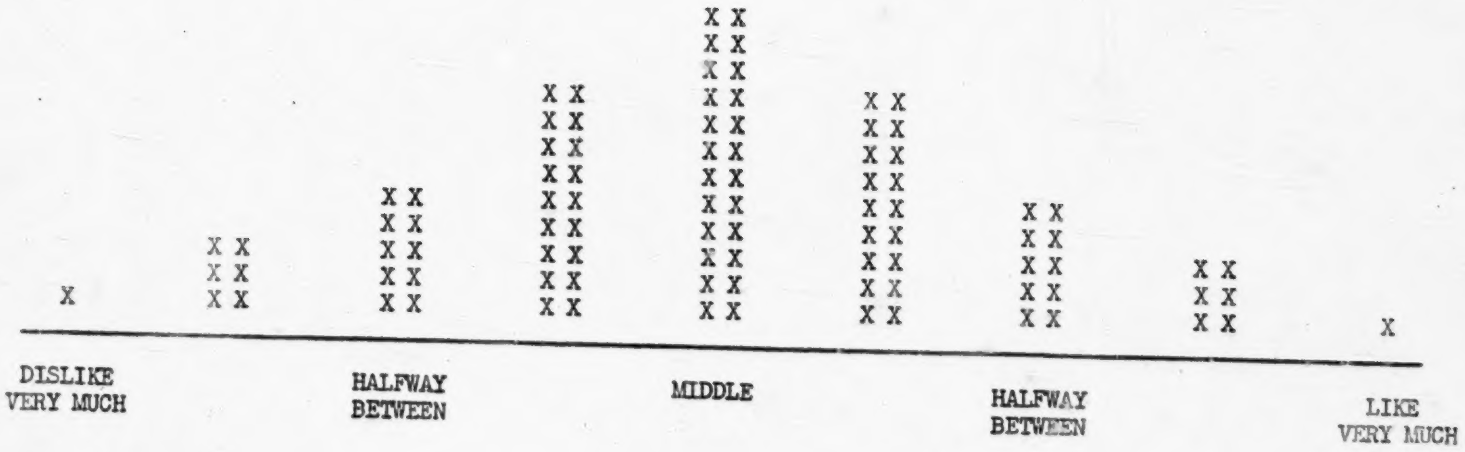
__COVER__ __SHEET__

AREA VIII Imagine that you are a high-level executive in a large oil company. Think of the X's as representing all possible high-level tasks or jobs which you might have in such a company. Think only of the kinds of activities involved and not of the salary and required training. Fill in the boxes below with your choices from these tasks or jobs. Use either job titles or kinds of work to be done.

ITEMS	Less than Dislike Very Much	DISLIKE VERY MUCH	HALFWAY BETWEEN	MIDDLE	HALFWAY BETWEEN	LIKE VERY MUCH	Better than Like Very Much
1. Determine company policy for preservation of native culture and native art							
2. Exploration to discover new oil fields							
3. Negotiate labor contracts							
4. Supervise financial activities							
5. Maintain contact with heads of foreign governments							
6. Direct public relations (write material to explain company policy)							
7. Serve as Chairman of the Board							
8. Direct research and development							
9. Supervise architecture and plant design							
10. Supervise production							
11. Determine nature & scope of charitable activities							
12. Create ideas for new products & new areas for expansion (basic research)							

DO NOT TURN COVER SHEET UNTIL YOU

HAVE FILLED IN THE BOXES



COVER SHEET

AREA IX Imagine that you are a member of a movie production crew. Think of the X's as representing all possible tasks you might have as a member of this crew. (Do not consider tasks carried out by actors, directors, or producers; in addition, consider only the nature of the work involved and not the salary or level of training required.) An example of such a task might be "cameraman". Fill in the boxes below with your choices from these tasks.

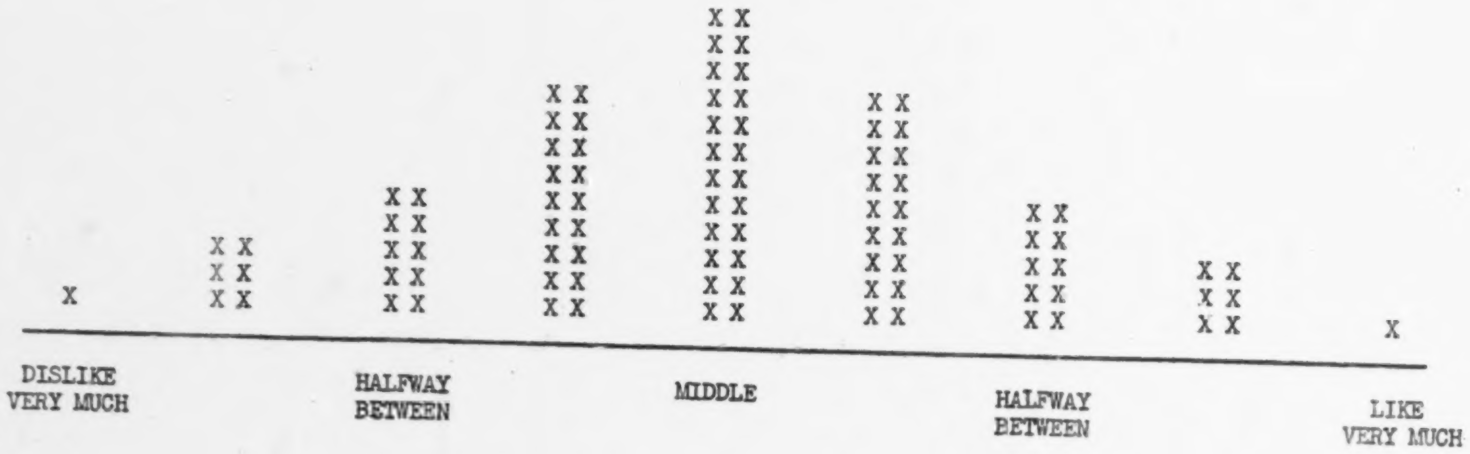
ITEMS	☐ DISLIKE VERY MUCH	☐ HALFWAY BETWEEN	☐ MIDDLE	☐ HALFWAY BETWEEN	☐ LIKE VERY MUCH
1. Accompany stars on city tours					
2. Design and build special stage equipment					
3. Analyze audience reaction to special techniques					
4. Perform as stuntman—standin for major actors in dangerous scenes					
5. Design special costumes					
6. Operate stage equipment					
7. Make arrangements for comfort & welfare of production crew and cast					
8. Edit film for artistic effects					
9. Hire extras					
10. Contact local theatres-arrange for sneak previews					
11. Edit and re-write scripts					
12. Plan production schedule					

Less than Dislike Very Much

Better than Like Very Much

DO NOT TURN COVER SHEET UNTIL YOU

HAVE FILLED IN THE BOXES

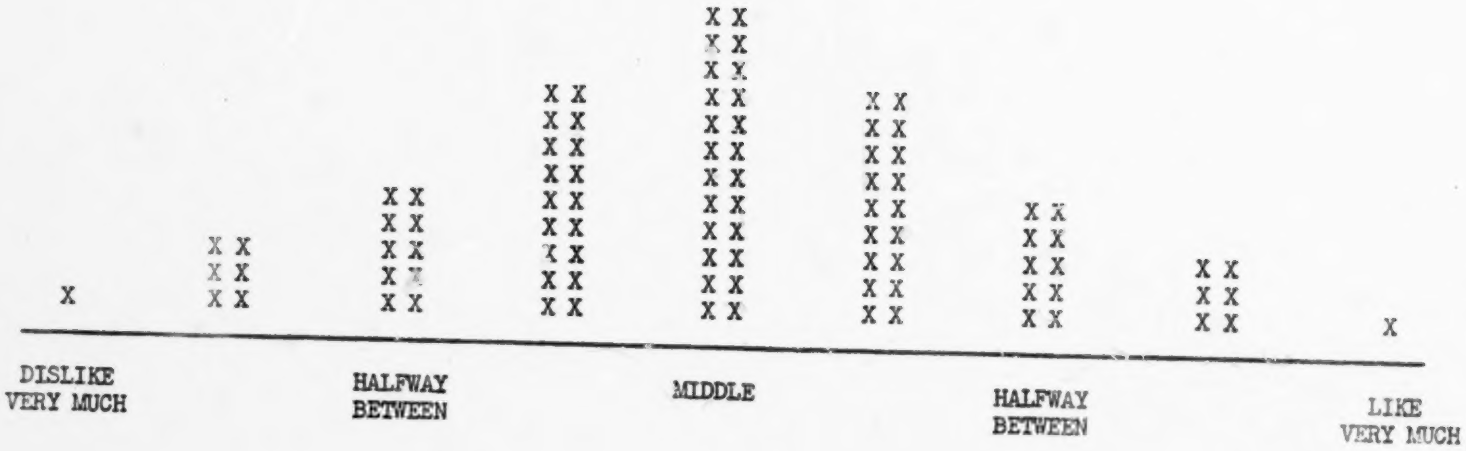


COVER SHEET

AREA X Imagine that you have been assigned as an observer on a governmental team which is studying aid programs in under-developed countries. Think of the X's as representing all possible reasons why one might wish to serve as an observer on such a team. An example of such a reason is "to check on the spending of the taxpayers' money". Fill in the boxes below with your choices from these reasons.

ITEMS	Less than Dislike Very Much	☐ DISLIKE VERY MUCH	☐ HALFWAY BETWEEN	☐ MIDDLE	☐ HALFWAY BETWEEN	☐ LIKE VERY MUCH	Better than Like Very Much
1. To get to know important leaders in the country							
2. Show natives how to operate modern machinery							
3. Determine possibilities for improving citizens' standard of living							
4. Clarify own ideas about foreign policy							
5. Learn to use a form of native art							
6. Collect information on which to make policy decisions about foreign aid							
7. Observe structure of local government							
8. Determine new uses for native raw materials							
9. Develop methods for influencing political trends in the country							
10. Collect native art works							
11. Experience excitement of visiting exotic countries							
12. Prepare informative articles about the mission							

DO NOT TURN COVER SHEET UNTIL YOU
HAVE FILLED IN THE BOXES



COVER SHEET

AREA XI Imagine that you have been drafted into the Army, and that you have been given the opportunity to choose your position as an enlisted man. Assume that there are no differences in opportunities for commissioning as an officer, for promotion, etc.; and that the amount of physical labor involved is similar for all groups. Think of the X's as representing all possible types of positions which are open to enlisted men. Fill in the boxes below with your choices from these types of positions. Think of a position and not of branches of services.

ITEMS	Less than Dislike Very Much	DISLIKE VERY MUCH	HALFWAY BETWEEN	MIDDLE	HALFWAY BETWEEN	LIKE VERY MUCH	Better than Like Very Much
1. Clerk, maintain & process personnel records							
2. Musician--play instrument in post band							
3. Mechanic--work in motor pool							
4. Military policeman							
5. Staffwriter for post newspaper							
6. Commando--training for hand-to-hand fighting and survival							
7. Motor operator--operate military vehicles							
8. Orderly for post commander							
9. Special Service-arrange for cultural events on the post							
10. Cryptographer--break enemy codes							
11. Chaplain's Assistant--assist Chaplain distributing welfare funds							
12. Recruiter--member of a recruiting team							

APPENDIX C

CANONICAL CORRELATION ANALYSES OF ORIGINAL INTEREST AREAS

APPENDIX C

CANONICAL CORRELATION ANALYSES OF ORIGINAL INTEREST AREAS[1]

Canonical Coefficient Number	Area Combinations (Two Areas Considered at a Time)											
	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	2,3	2,4
1	.67[2] .63[3]	.68 .72	.71 .66	.63 .67	.78 .67	.74 .65	.65 .57	.66 .67	.63 .59	.68 .64	.60 .68	.66 .63
2	.59 .54	.63 .56	.60 .60	.57 .56	.65 .63	.62 .57	.54 .53	.56 .56	.60 .53	.52 .52	.50 .49	.49 .51
3	.54 .48	.49 .52	.53 .54	.47 .47	.45 .55	.49 .49	.45 .45	.50 .47	.53 .47	.50 .45	.44 .43	.47 .46
4	.40 .42	.41 .48	.45 .51	.41 .42	.35 .45	.46 .47	.41 .40	.41 .41	.38 .45	.39 .40	.39 .36	.38 .41
5	.37 .34	.35 .43	.40 .44	.37 .36	.31 .39	.39 .34	.36 .37	.37 .36	.35 .40	.36 .35	.36 .35	.35 .36
6	.34 .30	.30 .31	.27 .33	.34 .32	.26 .28	.36 .30	.32 .33	.28 .24	.34 .30	.31 .31	.35 .28	.29 .30
7	.28 .28	.25 .26	.22 .29	.25 .27	.25 .27	.30 .30	.22 .30	.27 .18	.24 .26	.30 .29	.24 .25	.26 .25
8	.21 .23	.16 .23	.20 .25	.23 .24	.16 .24	.23 .24	.17 .21	.23 .15	.20 .20	.26 .19	.20 .22	.17 .18
9	.17 .18	.14 .20	.17 .22	.15 .18	.15 .17	.20 .20	.12 .15	.18 .14	.15 .14	.23 .14	.10 .16	.10 .17
10	.14 .06	.08 .16	.09 .10	.10 .09	.10 .11	.09 .14	.11 .10	.08 .08	.14 .12	.13 .13	.09 .07	.09 .12
11	.11 .03	.03 .05	.07 .04	.06 .03	.06 .05	.08 .10	.08 .07	.04 .05	.07 .05	.08 .04	.07 .04	.08 .03
12	.03 .01	.01 .01	.01 .02	.03 .00	.01 .04	.02 .04	.04 .00	.02 .02	.01 .00	.01 .01	.04 .03	.03 .01

Canonical Coefficient Number	Area Combinations											
	2,5	2,6	2,7	2,8	2,9	2,10	2,11	3,4	3,5	3,6	3,7	3,8
1	$\frac{.60}{.58}$	$\frac{.63}{.60}$	$\frac{.63}{.58}$	$\frac{.55}{.56}$	$\frac{.48}{.62}$	$\frac{.59}{.59}$	$\frac{.55}{.58}$	$\frac{.75}{.78}$	$\frac{.66}{.58}$	$\frac{.72}{.78}$	$\frac{.77}{.75}$	$\frac{.65}{.56}$
2	$\frac{.51}{.53}$	$\frac{.49}{.49}$	$\frac{.49}{.48}$	$\frac{.51}{.53}$	$\frac{.43}{.51}$	$\frac{.57}{.50}$	$\frac{.46}{.46}$	$\frac{.61}{.66}$	$\frac{.51}{.56}$	$\frac{.55}{.63}$	$\frac{.66}{.64}$	$\frac{.57}{.54}$
3	$\frac{.45}{.48}$	$\frac{.40}{.48}$	$\frac{.46}{.42}$	$\frac{.45}{.43}$	$\frac{.40}{.41}$	$\frac{.45}{.41}$	$\frac{.40}{.46}$	$\frac{.56}{.60}$	$\frac{.46}{.48}$	$\frac{.52}{.53}$	$\frac{.55}{.54}$	$\frac{.54}{.47}$
4	$\frac{.41}{.43}$	$\frac{.38}{.40}$	$\frac{.37}{.34}$	$\frac{.41}{.36}$	$\frac{.34}{.40}$	$\frac{.40}{.37}$	$\frac{.33}{.36}$	$\frac{.50}{.52}$	$\frac{.40}{.41}$	$\frac{.47}{.46}$	$\frac{.46}{.47}$	$\frac{.42}{.43}$
5	$\frac{.35}{.30}$	$\frac{.34}{.35}$	$\frac{.32}{.31}$	$\frac{.35}{.32}$	$\frac{.28}{.34}$	$\frac{.33}{.31}$	$\frac{.31}{.33}$	$\frac{.40}{.42}$	$\frac{.37}{.33}$	$\frac{.41}{.40}$	$\frac{.40}{.44}$	$\frac{.36}{.38}$
6	$\frac{.32}{.27}$	$\frac{.30}{.25}$	$\frac{.29}{.27}$	$\frac{.25}{.25}$	$\frac{.27}{.29}$	$\frac{.28}{.27}$	$\frac{.26}{.28}$	$\frac{.36}{.38}$	$\frac{.29}{.31}$	$\frac{.36}{.38}$	$\frac{.32}{.34}$	$\frac{.34}{.29}$
7	$\frac{.28}{.24}$	$\frac{.22}{.18}$	$\frac{.28}{.20}$	$\frac{.19}{.23}$	$\frac{.23}{.24}$	$\frac{.25}{.25}$	$\frac{.23}{.22}$	$\frac{.34}{.31}$	$\frac{.26}{.27}$	$\frac{.26}{.27}$	$\frac{.24}{.27}$	$\frac{.28}{.21}$
8	$\frac{.21}{.18}$	$\frac{.18}{.17}$	$\frac{.20}{.17}$	$\frac{.19}{.20}$	$\frac{.22}{.19}$	$\frac{.23}{.18}$	$\frac{.19}{.16}$	$\frac{.25}{.22}$	$\frac{.21}{.21}$	$\frac{.25}{.22}$	$\frac{.22}{.17}$	$\frac{.23}{.19}$
9	$\frac{.19}{.15}$	$\frac{.11}{.14}$	$\frac{.12}{.16}$	$\frac{.09}{.16}$	$\frac{.13}{.13}$	$\frac{.17}{.14}$	$\frac{.15}{.11}$	$\frac{.18}{.16}$	$\frac{.17}{.18}$	$\frac{.19}{.18}$	$\frac{.19}{.13}$	$\frac{.15}{.12}$
10	$\frac{.13}{.10}$	$\frac{.10}{.10}$	$\frac{.08}{.12}$	$\frac{.08}{.12}$	$\frac{.11}{.08}$	$\frac{.15}{.08}$	$\frac{.08}{.08}$	$\frac{.12}{.09}$	$\frac{.13}{.09}$	$\frac{.16}{.08}$	$\frac{.13}{.09}$	$\frac{.11}{.09}$
11	$\frac{.03}{.09}$	$\frac{.05}{.08}$	$\frac{.06}{.04}$	$\frac{.07}{.07}$	$\frac{.07}{.04}$	$\frac{.09}{.01}$	$\frac{.05}{.03}$	$\frac{.09}{.08}$	$\frac{.06}{.05}$	$\frac{.04}{.05}$	$\frac{.10}{.06}$	$\frac{.06}{.06}$
12	$\frac{.01}{.05}$	$\frac{.03}{.03}$	$\frac{.01}{.00}$	$\frac{.02}{.03}$	$\frac{.04}{.00}$	$\frac{.00}{.00}$	$\frac{.01}{.00}$	$\frac{.07}{.00}$	$\frac{.01}{.03}$	$\frac{.00}{.04}$	$\frac{.04}{.02}$	$\frac{.01}{.00}$

Canonical Coefficient Number	Area Combinations 3,9	3,10	3,11	4,5	4,6	4,7	4,8	4,9	4,10	4,11	5,6	5,7
1	$\frac{.62}{.67}$	$\frac{.61}{.69}$	$\frac{.70}{.75}$	$\frac{.67}{.64}$	$\frac{.79}{.76}$	$\frac{.80}{.67}$	$\frac{.65}{.62}$	$\frac{.66}{.70}$	$\frac{.69}{.68}$	$\frac{.74}{.70}$	$\frac{.58}{.63}$	$\frac{.65}{.63}$
2	$\frac{.54}{.58}$	$\frac{.58}{.54}$	$\frac{.54}{.58}$	$\frac{.52}{.52}$	$\frac{.70}{.73}$	$\frac{.68}{.64}$	$\frac{.58}{.50}$	$\frac{.53}{.60}$	$\frac{.64}{.58}$	$\frac{.52}{.50}$	$\frac{.55}{.60}$	$\frac{.52}{.45}$
3	$\frac{.49}{.46}$	$\frac{.49}{.46}$	$\frac{.46}{.45}$	$\frac{.47}{.48}$	$\frac{.59}{.61}$	$\frac{.56}{.52}$	$\frac{.47}{.50}$	$\frac{.52}{.53}$	$\frac{.53}{.52}$	$\frac{.48}{.45}$	$\frac{.45}{.50}$	$\frac{.46}{.39}$
4	$\frac{.43}{.43}$	$\frac{.38}{.43}$	$\frac{.41}{.41}$	$\frac{.36}{.43}$	$\frac{.55}{.50}$	$\frac{.55}{.48}$	$\frac{.40}{.46}$	$\frac{.39}{.46}$	$\frac{.44}{.41}$	$\frac{.45}{.43}$	$\frac{.42}{.42}$	$\frac{.40}{.35}$
5	$\frac{.29}{.38}$	$\frac{.35}{.37}$	$\frac{.35}{.33}$	$\frac{.33}{.37}$	$\frac{.45}{.47}$	$\frac{.43}{.41}$	$\frac{.34}{.43}$	$\frac{.32}{.34}$	$\frac{.32}{.34}$	$\frac{.33}{.31}$	$\frac{.33}{.37}$	$\frac{.34}{.32}$
6	$\frac{.27}{.27}$	$\frac{.25}{.23}$	$\frac{.29}{.31}$	$\frac{.29}{.32}$	$\frac{.40}{.38}$	$\frac{.36}{.35}$	$\frac{.21}{.30}$	$\frac{.28}{.32}$	$\frac{.29}{.30}$	$\frac{.32}{.28}$	$\frac{.29}{.29}$	$\frac{.24}{.31}$
7	$\frac{.26}{.24}$	$\frac{.23}{.21}$	$\frac{.23}{.23}$	$\frac{.23}{.25}$	$\frac{.34}{.33}$	$\frac{.30}{.25}$	$\frac{.18}{.23}$	$\frac{.18}{.26}$	$\frac{.26}{.28}$	$\frac{.28}{.22}$	$\frac{.29}{.29}$	$\frac{.22}{.24}$
8	$\frac{.21}{.14}$	$\frac{.18}{.18}$	$\frac{.18}{.22}$	$\frac{.16}{.20}$	$\frac{.32}{.23}$	$\frac{.22}{.21}$	$\frac{.14}{.18}$	$\frac{.14}{.21}$	$\frac{.21}{.20}$	$\frac{.26}{.18}$	$\frac{.19}{.23}$	$\frac{.15}{.20}$
9	$\frac{.12}{.09}$	$\frac{.17}{.15}$	$\frac{.17}{.14}$	$\frac{.13}{.14}$	$\frac{.23}{.18}$	$\frac{.20}{.14}$	$\frac{.14}{.16}$	$\frac{.12}{.16}$	$\frac{.17}{.15}$	$\frac{.18}{.13}$	$\frac{.14}{.19}$	$\frac{.13}{.14}$
10	$\frac{.09}{.05}$	$\frac{.12}{.09}$	$\frac{.13}{.10}$	$\frac{.08}{.10}$	$\frac{.10}{.08}$	$\frac{.11}{.10}$	$\frac{.07}{.12}$	$\frac{.07}{.12}$	$\frac{.12}{.13}$	$\frac{.14}{.07}$	$\frac{.11}{.12}$	$\frac{.10}{.12}$
11	$\frac{.06}{.03}$	$\frac{.06}{.05}$	$\frac{.05}{.08}$	$\frac{.06}{.06}$	$\frac{.07}{.03}$	$\frac{.10}{.07}$	$\frac{.05}{.07}$	$\frac{.05}{.09}$	$\frac{.04}{.06}$	$\frac{.08}{.03}$	$\frac{.04}{.12}$	$\frac{.02}{.06}$
12	$\frac{.01}{.02}$	$\frac{.00}{.01}$	$\frac{.03}{.02}$	$\frac{.01}{.01}$	$\frac{.03}{.01}$	$\frac{.03}{.01}$	$\frac{.02}{.01}$	$\frac{.02}{.02}$	$\frac{.02}{.02}$	$\frac{.01}{.00}$	$\frac{.01}{.01}$	$\frac{.00}{.02}$

Canonical Coefficient	Area Combinations											
Number	5,8	5,9	5,10	5,11	6,7	6,8	6,9	6,10	6,11	7,8	7,9	7,10
1	$\frac{.53}{.58}$	$\frac{.54}{.61}$	$\frac{.61}{.60}$	$\frac{.62}{.63}$	$\frac{.83}{.72}$	$\frac{.70}{.62}$	$\frac{.69}{.72}$	$\frac{.67}{.69}$	$\frac{.64}{.76}$	$\frac{.67}{.62}$	$\frac{.69}{.70}$	$\frac{.72}{.64}$
2	$\frac{.48}{.55}$	$\frac{.50}{.53}$	$\frac{.57}{.51}$	$\frac{.50}{.51}$	$\frac{.76}{.67}$	$\frac{.63}{.54}$	$\frac{.61}{.62}$	$\frac{.56}{.65}$	$\frac{.57}{.58}$	$\frac{.64}{.60}$	$\frac{.61}{.57}$	$\frac{.61}{.54}$
3	$\frac{.40}{.50}$	$\frac{.39}{.47}$	$\frac{.51}{.44}$	$\frac{.44}{.47}$	$\frac{.60}{.56}$	$\frac{.46}{.48}$	$\frac{.55}{.58}$	$\frac{.54}{.46}$	$\frac{.48}{.51}$	$\frac{.51}{.49}$	$\frac{.44}{.48}$	$\frac{.53}{.43}$
4	$\frac{.38}{.43}$	$\frac{.37}{.38}$	$\frac{.38}{.39}$	$\frac{.43}{.41}$	$\frac{.52}{.48}$	$\frac{.44}{.45}$	$\frac{.36}{.49}$	$\frac{.38}{.42}$	$\frac{.36}{.47}$	$\frac{.43}{.40}$	$\frac{.43}{.45}$	$\frac{.38}{.38}$
5	$\frac{.29}{.32}$	$\frac{.35}{.36}$	$\frac{.33}{.33}$	$\frac{.36}{.35}$	$\frac{.39}{.37}$	$\frac{.36}{.39}$	$\frac{.32}{.36}$	$\frac{.30}{.39}$	$\frac{.33}{.28}$	$\frac{.40}{.33}$	$\frac{.39}{.37}$	$\frac{.35}{.34}$
6	$\frac{.28}{.28}$	$\frac{.25}{.30}$	$\frac{.33}{.29}$	$\frac{.31}{.32}$	$\frac{.35}{.35}$	$\frac{.35}{.35}$	$\frac{.26}{.33}$	$\frac{.25}{.28}$	$\frac{.29}{.26}$	$\frac{.31}{.30}$	$\frac{.30}{.32}$	$\frac{.30}{.28}$
7	$\frac{.22}{.23}$	$\frac{.22}{.25}$	$\frac{.23}{.23}$	$\frac{.23}{.31}$	$\frac{.26}{.31}$	$\frac{.23}{.31}$	$\frac{.23}{.23}$	$\frac{.23}{.23}$	$\frac{.26}{.26}$	$\frac{.27}{.27}$	$\frac{.25}{.23}$	$\frac{.29}{.22}$
8	$\frac{.17}{.20}$	$\frac{.19}{.21}$	$\frac{.20}{.21}$	$\frac{.20}{.18}$	$\frac{.26}{.26}$	$\frac{.19}{.18}$	$\frac{.20}{.21}$	$\frac{.15}{.19}$	$\frac{.18}{.20}$	$\frac{.23}{.19}$	$\frac{.21}{.17}$	$\frac{.26}{.20}$
9	$\frac{.17}{.14}$	$\frac{.12}{.17}$	$\frac{.16}{.16}$	$\frac{.17}{.14}$	$\frac{.17}{.18}$	$\frac{.15}{.16}$	$\frac{.12}{.13}$	$\frac{.11}{.18}$	$\frac{.16}{.14}$	$\frac{.18}{.15}$	$\frac{.19}{.15}$	$\frac{.14}{.16}$
10	$\frac{.13}{.09}$	$\frac{.11}{.08}$	$\frac{.08}{.14}$	$\frac{.14}{.12}$	$\frac{.14}{.10}$	$\frac{.11}{.11}$	$\frac{.09}{.07}$	$\frac{.05}{.08}$	$\frac{.12}{.13}$	$\frac{.15}{.07}$	$\frac{.13}{.10}$	$\frac{.11}{.09}$
11	$\frac{.07}{.06}$	$\frac{.05}{.06}$	$\frac{.05}{.08}$	$\frac{.07}{.07}$	$\frac{.12}{.07}$	$\frac{.06}{.06}$	$\frac{.07}{.04}$	$\frac{.02}{.04}$	$\frac{.08}{.09}$	$\frac{.10}{.04}$	$\frac{.11}{.02}$	$\frac{.10}{.06}$
12	$\frac{.01}{.02}$	$\frac{.04}{.01}$	$\frac{.02}{.01}$	$\frac{.00}{.01}$	$\frac{.02}{.04}$	$\frac{.03}{.04}$	$\frac{.00}{.01}$	$\frac{.00}{.01}$	$\frac{.01}{.02}$	$\frac{.03}{.02}$	$\frac{.02}{.00}$	$\frac{.03}{.02}$

Canonical Coefficient Number	Area Combinations 7,11	8,9	8,10	8,11	9,10	9,11	10,11
1	$\frac{.72}{.74}$	$\frac{.67}{.66}$	$\frac{.69}{.63}$	$\frac{.66}{.67}$	$\frac{.58}{.66}$	$\frac{.70}{.76}$	$\frac{.62}{.69}$
2	$\frac{.59}{.66}$	$\frac{.60}{.60}$	$\frac{.53}{.60}$	$\frac{.57}{.52}$	$\frac{.56}{.59}$	$\frac{.55}{.56}$	$\frac{.50}{.50}$
3	$\frac{.53}{.49}$	$\frac{.56}{.50}$	$\frac{.51}{.45}$	$\frac{.50}{.48}$	$\frac{.53}{.48}$	$\frac{.51}{.51}$	$\frac{.42}{.44}$
4	$\frac{.48}{.47}$	$\frac{.44}{.36}$	$\frac{.42}{.42}$	$\frac{.44}{.44}$	$\frac{.39}{.40}$	$\frac{.44}{.44}$	$\frac{.39}{.34}$
5	$\frac{.40}{.43}$	$\frac{.36}{.30}$	$\frac{.30}{.33}$	$\frac{.37}{.35}$	$\frac{.31}{.34}$	$\frac{.32}{.40}$	$\frac{.37}{.30}$
6	$\frac{.38}{.33}$	$\frac{.32}{.28}$	$\frac{.28}{.29}$	$\frac{.26}{.30}$	$\frac{.29}{.30}$	$\frac{.28}{.38}$	$\frac{.29}{.26}$
7	$\frac{.27}{.32}$	$\frac{.29}{.22}$	$\frac{.22}{.23}$	$\frac{.23}{.25}$	$\frac{.23}{.22}$	$\frac{.19}{.30}$	$\frac{.25}{.23}$
8	$\frac{.25}{.25}$	$\frac{.19}{.19}$	$\frac{.20}{.18}$	$\frac{.18}{.23}$	$\frac{.20}{.19}$	$\frac{.16}{.27}$	$\frac{.21}{.21}$
9	$\frac{.13}{.19}$	$\frac{.17}{.13}$	$\frac{.10}{.13}$	$\frac{.15}{.17}$	$\frac{.15}{.18}$	$\frac{.14}{.26}$	$\frac{.17}{.16}$
10	$\frac{.11}{.15}$	$\frac{.13}{.06}$	$\frac{.07}{.10}$	$\frac{.12}{.12}$	$\frac{.13}{.14}$	$\frac{.11}{.13}$	$\frac{.10}{.09}$
11	$\frac{.07}{.12}$	$\frac{.08}{.02}$	$\frac{.04}{.09}$	$\frac{.07}{.06}$	$\frac{.09}{.08}$	$\frac{.04}{.07}$	$\frac{.06}{.07}$
12	$\frac{.01}{.01}$	$\frac{.01}{.01}$	$\frac{.03}{.02}$	$\frac{.05}{.00}$	$\frac{.01}{.02}$	$\frac{.01}{.04}$	$\frac{.01}{.01}$

---

[1] See p.74 to determine significant canonical correlations by Kullback test of significance.

[2] Correlation above the line based on original sample of 188 subjects.

[3] Correlation below the line based on first reliability sample of 182 subjects.

APPENDIX D

CORRELATION OF ITEMS WITHIN A FACTOR WITH FACTOR TOTAL

APPENDIX D

CORRELATION OF ITEMS WITHIN A FACTOR WITH FACTOR TOTAL[1]

FACTOR	AREA	ITEM	MEAN	VARIANCE	ITEM-FACTOR r R(n,T-n)
1 ADVENTUROUS	1	Opportunity for excitement & adventure	6.69	3.10	.53
	2	Seeking new worlds to conquer	5.84	4.34	.04
	3	Explore a little-known section of a nearby city	5.64	4.78	.11
	4	Taming the Wilderness	5.22	5.50	.38
	5	Adventurous & daring people	5.99	4.21	.34
	6	Lives of great explorers	5.45	3.86	.37
	7	Physical education & sports	5.24	6.89	.36
	8	Exploration to discover new oil fields	6.41	4.26	.26
	9	Perform as stuntman--standin for major actors in dangerous scenes	4.30	8.09	.37
	10	Experience excitement of visiting exotic countries	5.54	6.46	.28
	11	Commando-training for hand-to-hand fighting & survivel	5.00	6.55	.39
2 LINGUISTIC, MANIPULATIVE FOR OWN ENDS	1	Opportunity to influence people or to manage others	6.59	3.44	.46
	2	The world is his oyster	4.50	6.38	.15
	3	Urge friends to join you in some activity	5.91	4.48	.37
	4	Improving your personality	5.26	5.83	.30
	5	Dominant, persuasive people	3.42	5.10	.31
	6	Books on how to make a good impression--how to be persuasive	4.35	4.42	.49
	7	Advertising, salesmanship	3.88	6.51	.37

---

[1] Total scores corrected for item score.

FACTOR	AREA	ITEM	MEAN	VARIANCE	ITEM-FACTOR r
2	8	Negotiate labor contracts	4.92	5.96	.42
	9	Contact local theatres--arrange for sneak previews	4.42	5.64	.50
	10	Develop methods for influencing political trends in the country	4.91	5.04	.39
	11	Recruiter--member of a recruiting team	3.58	6.24	.27
3 DETAIL, ORDER	1	Opportunity to work in orderly, systematic manner	5.63	4.65	.37
	2	Systematic, dependable, businesslike	5.99	4.38	.43
	3	Arrange a stamp collection	2.40	4.20	.12
	4	Using your time effectively	5.16	4.83	.25
	5	Systematic, well-organized, prompt people	6.04	4.03	.46
	6	Books on methods of cost accounting	3.16	5.08	.60
	7	Accounting	3.49	6.43	.51
	8	Supervise financial activities	4.47	5.63	.38
	9	Plan production schedule	4.76	5.50	.33
	10	Observe structure of local government	5.15	4.39	.18
	11	Clerk--maintain & process personnel records	3.17	5.25	.42
4 NURTURANCE	1	Opportunity to help others	6.30	3.27	.40
	2	A friend indeed	6.55	3.10	.20
	3	Work with group of youngsters at the Boys' Club	4.91	4.68	.53
	4	Humane care for animals	3.92	4.38	.30
	5	Sympathetic people	5.24	3.92	.28

FACTOR	AREA	ITEM	MEAN	VARIANCE	ITEM-FACTOR r
4	6	Books on discoveries which have helped mankind	5.78	3.86	.13
	7	Social Welfare	4.04	5.17	.58
	8	Determine nature & scope of charitable activities	4.29	4.66	.43
	9	Make arrangements for comfort & welfare of production crew and cast	3.66	5.35	.42
	10	Determine possibilities for improving citizens' standard of living	6.21	3.51	.39
	11	Chaplain's Assistant--assist Chaplain distributing welfare funds	3.01	4.94	.40
5 OVERT, IMPERSONAL CONTROL AS RESULT OF POSITION	1	Opportunity to be in responsible position-- a leader	6.80	2.84	.54
	2	A born leader	6.68	2.80	.47
	3	Plan meeting of committee of which you are chairman	4.22	4.48	.42
	4	The responsibilities of leadership	5.55	4.70	.47
	5	Leaders	6.32	3.02	.49
	6	Books about successful executives	3.92	5.79	.56
	7	Personnel administration	4.66	5.88	.54
	8	Serve as Chairman of the Board	5.70	5.14	.45
	9	Hire extras	4.37	5.40	.52
	10	Collect information on which to make policy decisions about foreign aid	5.33	4.58	.26
	11	Military policeman	4.10	5.60	.06

FACTOR	AREA	ITEM	MEAN	VARIANCE	ITEM FACTOR r
6 ESTEEM SEEKING, STATUS SEEKING	1	To associate with important or key people	6.07	3.74	.50
	2	BMOC -- Big Man on Campus	4.23	6.00	.28
	3	Read society page in local paper	2.24	3.56	.34
	4	Lives of important people	4.62	4.89	.34
	5	Famous people	5.30	3.98	.35
	6	Books on etiquette	3.11	4.12	.31
	7	Foreign service--diplomacy	4.88	6.04	.35
	8	Maintain contact with heads of foreign governments	6.00	4.73	.41
	9	Accompany stars on city tours	4.76	6.66	.36
	10	To get to know important leaders in the country	5.31	5.37	.49
	11	Orderly for post commander	3.34	5.73	.30
7 LINGUISTIC EXPRESSION	1	Opportunity to write--to express my thoughts	6.34	4.03	.59
	2	The pen is mightier than the sword	5.09	4.28	.26
	3	Write a short story or article for school magazine	3.59	5.10	.63
	4	How to write a short-story--the writer's craft	3.63	4.97	.65
	5	Fluent, articulate people--people who can use words	5.70	3.35	.39
	6	Books on self-expression (speaking)	4.38	4.73	.36
	7	Creative writing	4.22	6.14	.70
	8	Direct public relations (write material to explain company policy)	4.77	5.58	.47

FACTOR	AREA	ITEM	MEAN	VARIANCE	ITEM FACTOR r
7	9	Edit and re-write scripts	4.08	6.44	.55
	10	Prepare informative articles about the mission	4.70	5.65	.49
	11	Staffwriter for post newspaper	3.73	5.21	.61
8 CONCRETE, NON-OPERATIVE MEANS	1	Opportunity to devise concrete methods for attaining some goal	6.54	2.97	.23
	2	If he can't fix it, throw it away	3.93	5.67	.11
	3	Design and build a hi-fi unit	4.50	5.42	.35
	4	Peaceful uses of atomic energy	5.57	4.34	.36
	5	Ingenious people--those who can make practical application of ideas	6.29	2.29	.20
	6	Books on how to construct equipment or how to build objects	4.72	4.68	.57
	7	Organic chemistry	3.93	6.31	.44
	8	Direct research and development	6.15	3.90	.44
	9	Design & build special stage equipment	4.84	5.82	.22
	10	Determine new uses for native raw materials	5.34	4.20	.48
	11	Mechanic--work in motor pool	3.40	4.53	.21
9 ABSTRACT THINKING, IDEAS	1	Opportunity to think--to work with ideas	6.84	3.30	.55
	2	Egghead-- a true scholar	4.97	6.62	.13
	3	Collect my thoughts about some new scientific or philosophical theory	4.11	6.36	.64
	4	Great ideas of our time	5.87	4.67	.52

FACTOR	AREA	ITEM	MEAN	VARIANCE	ITEM FACTOR r
9	5	People with keen minds	6.74	2.54	.28
	6	Books on theoretical and abstract topics	4.42	6.32	.51
	7	Philosophy or mathematics	4.99	5.59	.43
	8	Create ideas for new products & new areas for expansion (basic research)	6.10	3.78	.27
	9	Analyze audience reaction to special techniques	5.44	4.76	.28
	10	Clarify own ideas about foreign policy	5.90	3.91	.27
	11	Cryptographer--break enemy codes	5.06	5.63	.31
10 CONCRETE OPERATIVE MEANS	1	Opportunity to work with equipment	5.06	4.62	.54
	2	Genius at running equipment	4.85	4.69	.45
	3	Try out a new power tool	4.11	3.73	.53
	4	The Operating Procedure in an Atomic Reactor	4.68	6.39	.34
	5	People who can make things work	5.68	2.55	.40
	6	Books on operation of equipment and apparatus	4.08	5.66	.63
	7	Industrial technology	4.27	5.84	.59
	8	Supervise production	5.70	3.66	.23
	9	Operate stage equipment	4.08	3.80	.34
	10	Show natives how to operate modern machinery	5.26	4.00	.44
	11	Motor Operator--operate military vehicles	4.57	4.44	.33

FACTOR	AREA	ITEM	MEAN	VARIANCE	ITEM FACTOR r
11 AESTHETIC APPRECIATION	1	Opportunity to use my artistic ability	4.85	6.11	.57
	2	He'll go far in the arts	5.01	4.77	.46
	3	Indulge in some creative activity such as painting	4.52	5.44	.56
	4	Developing your artistic skills	3.63	5.80	.73
	5	Talented people	6.06	2.60	.17
	6	Books on sketching or painting techniques	3.16	5.19	.65
	7	Creative art and/or music	3.79	6.66	.70
	8	Supervise architecture and plant design	5.75	5.44	.37
	9	Design special costumes	3.30	3.95	.28
	10	Learn to use a form of native art	4.02	5.15	.58
	11	Musician--play instrument in post band	3.02	5.41	.42
12 AESTHETIC EXPRESSION	1	Opportunity to enjoy the beauty around me	6.44	3.67	.23
	2	Highbrow--appreciate the finer things in life	5.32	4.97	.33
	3	Listen to new record album	5.22	4.56	.23
	4	Appreciating modern art	3.36	6.71	.64
	5	Cultured people	5.94	2.60	.32
	6	Collections of famous works of art	3.21	5.24	.64
	7	Aesthetics--music or art appreciation	3.86	6.51	.69
	8	Determine company policy for preservation of native culture and native art	4.83	6.17	.42

FACTOR	AREA	ITEM	MEAN	VARIANCE	ITEM FACTOR r
12	9	Edit film for artistic effects	5.05	4.58	.43
	10	Collect native art works	3.85	5.76	.53
	11	Special Service--arrange for cultural events on the post	4.36	6.32	.51

APPENDIX E

CORRELATION OF ITEMS WITH FACTOR TOTALS

APPENDIX E

Correlation of Items with Factor Totals[1]

Area	Factor Item	Factor Number 1	2	3	4	5	6	7	8	9	10	11	12
1	1	.53	-.01	.01	.06	.03	.07	-.26	.16	-.22	.24	-.05	-.11
	2	.06	.46	.32	.16	.58	.45	.17	.01	.11	.04	-.05	-.04
	3	-.00	.03	.37	.11	.06	-.05	-.05	.16	-.00	.14	-.04	-.02
	4	.00	.14	.09	.40	.17	.15	.11	.01	.07	.07	.06	.06
	5	.00	.43	.35	.11	.54	.31	.05	-.05	.03	-.00	-.27	-.12
	6	.07	.43	.30	.18	.44	.50	.15	.03	.11	.08	.02	.09
	7	-.21	.11	-.05	.12	.06	.18	.59	-.14	.43	-.37	.29	.38
	8	.01	.07	.13	-.02	.09	.07	.07	.23	.28	.18	.11	.04
	9	-.16	-.06	-.11	.01	-.04	-.06	.32	.17	.55	-.09	.38	.30
	10	.24	-.09	-.03	.01	-.12	-.06	-.29	.41	-.21	.54	.08	-.10
	11	-.02	-.19	-.18	-.08	-.28	-.11	.10	.19	.26	-.01	.57	.41
	12	.30	-.16	-.06	.13	-.16	-.08	.09	.06	.01	-.00	.28	.23
2	1	.04	.23	.19	.14	.17	.18	.17	.16	.28	.07	.12	.12
	2	.04	.15	.07	.03	.14	.18	.09	-.04	.04	-.08	.02	.03
	3	.05	.18	.43	.09	.27	.05	-.05	.10	-.09	.16	-.22	-.08
	4	.20	.15	.20	.20	.08	.04	-.02	.07	-.02	.15	.04	.09
	5	.10	.44	.33	.12	.47	.30	.02	-.10	-.00	.01	-.20	-.11
	6	.22	.35	.03	.07	.28	.28	-.03	-.10	-.13	-.02	-.07	-.07
	7	.04	.18	.22	.19	.15	.12	.26	.00	.22	-.08	.08	.16
	8	-.07	.05	-.02	.01	-.08	.02	-.09	.11	.11	.12	-.01	-.04
	9	.04	.01	.05	.00	.10	.08	.11	-.09	.13	-.14	.02	.11
	10	.16	.07	.15	.14	.06	.05	-.20	.36	-.01	.45	.02	-.14
	11	-.06	-.03	.06	.21	-.03	.12	.28	.06	.33	-.05	.46	.42
	12	.01	.14	.19	.02	.18	.14	.25	.01	.28	-.12	.25	.33

---

[1] The item is removed from its own factor total.

Area	Factor Item	Factor Number											
		1	2	3	4	5	6	7	8	9	10	11	12
3	1	.11	.08	.08	.01	.06	.12	.08	.00	.02	-.01	.04	.16
	2	.17	.37	.19	.29	.38	.31	.06	.06	-.05	.15	-.10	-.04
	3	-.10	.03	.12	.09	-.01	.11	.17	.19	.23	.03	.22	.27
	4	.22	.21	.15	.53	.29	.21	.13	-.03	.01	.10	-.09	-.00
	5	-.03	.52	.36	.24	.42	.47	.35	-.08	.24	-.12	.04	.16
	6	.02	.23	.03	.07	.21	.34	.05	-.18	-.15	-.04	-.05	.02
	7	-.14	.09	-.04	.09	.03	.07	.63	-.14	.42	-.34	.24	.36
	8	.04	-.13	.22	-.04	-.07	-.04	-.07	.35	.16	.37	.12	.08
	9	-.26	-.07	.05	.08	-.10	-.01	.36	.11	.64	-.22	.30	.42
	10	.27	-.00	.22	.03	.04	-.07	-.34	.40	-.20	.53	-.02	-.18
	11	-.04	-.17	-.05	-.05	-.20	-.05	.28	.12	.40	-.07	.56	.60
	12	.03	-.06	.06	.02	-.07	.07	.02	.05	.13	-.04	.24	.23
4	1	.38	.03	.10	.20	.05	.01	-.13	.14	-.26	.23	-.04	-.09
	2	.17	.30	.35	.34	.36	.32	.03	-.02	-.12	.17	-.02	.02
	3	.26	.31	.25	.34	.30	.23	.10	.08	.06	.16	.04	.06
	4	.29	.01	.03	.30	-.02	.02	-.02	.16	-.06	.20	.10	.04
	5	.12	.53	.30	.32	.47	.32	.17	-.13	.01	.01	-.17	-.07
	6	-.04	.25	.14	.27	.29	.34	.41	-.15	.26	-.20	.20	.25
	7	-.08	.12	-.02	.12	-.02	.05	.65	-.10	.35	-.32	.30	.41
	8	.18	-.04	.08	.16	.01	-.01	-.12	.36	.23	.36	-.01	-.07
	9	-.08	.03	.04	.12	.02	.07	.40	.06	.52	-.20	.32	.38
	10	.17	-.11	.10	-.03	-.09	-.09	-.26	.62	.20	.34	.00	-.13
	11	-.04	-.04	-.06	.13	-.13	.07	.34	.07	.28	-.07	.73	.60
	12	-.13	.04	-.02	.14	-.07	.09	.48	-.15	.34	-.21	.61	.64

Area	Factor Item	1	2	3	4	5	6	7	8	9	10	11	12
							Factor Number						
5	1	.34	.10	.05	.04	.14	-.00	.02	.09	.14	.08	-.02	.00
	2	.00	.31	.20	.13	.32	.23	.20	.02	.05	-.03	.03	.10
	3	.06	.33	.46	.21	.32	.27	.06	.09	-.02	.11	-.16	.01
	4	-.09	.17	.21	.28	.11	.18	.13	-.12	-.02	-.05	.03	.07
	5	.21	.50	.27	.25	.49	.46	.17	-.04	-.06	.04	-.07	-.05
	6	.14	.29	.26	.17	.33	.35	.19	-.05	.15	-.02	.19	.14
	7	-.04	.15	.08	.07	.15	.30	.39	-.08	.30	-.27	.21	.27
	8	-.02	.17	.23	.08	.21	.13	.25	.20	.28	.19	.14	.01
	9	-.06	.12	.12	-.02	.17	.09	.35	-.01	.28	-.14	.18	.24
	10	.18	.21	.15	.17	.15	.22	-.09	.35	-.01	.40	.05	-.11
	11	.10	.29	.09	.14	.29	.23	.27	-.04	.20	-.08	.17	.25
	12	-.04	.29	.18	.06	.27	.30	.28	-.01	.23	-.06	.17	.32
6	1	.37	.17	.10	.25	.15	.28	.04	.14	-.04	.20	.08	.09
	2	-.03	.49	.40	.21	.47	.40	.23	-.04	.03	-.00	.08	.14
	3	.10	.38	.60	.15	.45	.31	-.10	.08	-.04	.25	-.11	-.04
	4	.12	.10	.07	.13	.07	.21	.03	.26	.24	.15	.06	.07
	5	.00	.54	.46	.11	.56	.56	.10	-.10	-.04	.03	-.15	-.00
	6	.07	.41	.32	.31	.33	.31	.08	.02	-.10	.12	.12	.16
	7	-.08	.40	.28	.24	.37	.29	.36	-.19	.14	-.10	.14	.24
	8	.27	-.06	.15	.02	-.04	-.07	-.32	.57	-.09	.65	.02	-.17
	9	-.20	-.09	-.12	.04	-.13	-.10	.26	.12	.51	-.16	.28	.31
	10	.31	-.01	.11	.07	-.06	-.00	-.36	.57	-.22	.63	-.00	-.17
	11	.01	-.08	-.06	.05	-.16	-.02	.24	.12	.22	-.06	.65	.52
	12	-.13	-.02	-.07	.08	-.07	.10	.48	-.11	.36	-.28	.62	.64

Area	Factor Item	Factor Number											
		1	2	3	4	5	6	7	8	9	10	11	12
7	1	.36	.08	.02	.16	.03	.07	-.28	.10	-.37	.33	-.03	-.14
	2	.05	.37	.40	.07	.46	.33	.17	-.13	-.10	.09	-.09	-.05
	3	.03	.33	.51	.07	.39	.23	-.16	.06	-.13	.22	-.22	-.23
	4	.01	.26	.10	.58	.26	.32	.28	-.18	.10	-.11	.01	.14
	5	.02	.58	.47	.29	.54	.47	.17	-.07	.03	.06	-.11	.01
	6	-.03	.38	.20	.32	.39	.35	.44	-.12	.31	-.18	.05	20
	7	-.10	.07	-.15	.09	.01	.13	.70	-.26	.37	-.44	.38	.52
	8	.11	-.13	.01	.04	-.21	-.09	-.33	.44	-.01	.46	.03	-.20
	9	-.21	-.16	.04	-.04	-.18	-.19	.19	.19	.43	-.08	.18	.16
	10	.27	.13	.25	.01	.11	-.04	-.36	.50	-.10	.59	-.10	-.29
	11	-.10	-.10	-.13	.12	-.16	-.04	.44	-.05	.33	-.23	.70	.70
	12	-.07	-.05	-.09	.15	-.08	.05	.45	-.08	.33	-.24	.65	.69
8	1	.26	-.09	-.07	-.00	-.16	-.08	-.22	.47	.01	.41	.15	.04
	2	-.00	.42	.34	.25	.56	.38	.17	-.17	.02	-.03	-.12	.02
	3	.01	.44	.38	.10	.47	.32	-.09	.16	-.01	.22	-.08	-.08
	4	.06	.27	.18	.43	.18	.28	.27	-.06	.12	-.03	.28	.40
	5	-.10	.49	.34	.07	.45	.40	.22	-.01	.12	-.06	.05	.15
	6	-.06	.47	.24	.30	.49	.41	.36	-.08	.24	-.08	.04	.18
	7	-.18	.44	.23	.36	.40	.35	.47	-.21	.28	-.28	.14	.34
	8	.16	-.02	.06	-.03	-.10	-.12	-.05	.44	.24	.31	.14	.03
	9	.02	-.07	.00	.03	-.10	-.10	.05	.45	.27	.18	.16	.10
	10	.15	.25	.25	.02	.23	.11	-.18	.17	-.18	.23	-.13	-.21
	11	.16	-.13	-.01	-.03	-.17	-.09	-.08	.46	.08	.36	.37	.21
	12	-.05	.04	.04	.16	.03	.05	.27	-.01	.34	-.17	.39	.42

Area	Factor Item	Factor Number 1	2	3	4	5	6	7	8	9	10	11	12
9	1	.37	.01	-.08	.08	.00	.02	-.16	-.07	-.25	.07	-.15	-.20
	2	.12	.50	.36	.24	.56	.42	.20	-.07	.03	.00	-.09	.03
	3	.04	.43	.33	.11	.45	.25	.28	-.04	.17	-.06	-.02	.06
	4	.04	.35	.32	.42	.26	.34	.09	-.04	.00	.07	.10	.18
	5	.07	.56	.36	.21	.52	.42	.08	-.09	-.08	.06	-.11	-.02
	6	.18	.33	.25	.10	.35	.36	-.14	.02	-.20	.15	-.12	-.07
	7	-.21	.08	-.08	.02	.07	.06	.55	-.27	.32	-.47	.20	.39
	8	.07	-.09	.01	-.04	-.13	-.10	-.05	.22	.12	.28	.37	.21
	9	-.17	.32	.16	.25	.30	.30	.36	-.04	.28	-.13	.11	.24
	10	.02	-.11	.02	.08	-.11	-.04	-.22	.35	-.03	.34	.07	-.07
	11	.14	.17	.06	.17	.10	.25	.14	.06	.07	.10	.28	.25
	12	-.16	.06	.06	.17	.02	.12	.37	-.04	.30	-.18	.35	.43
10	1	.28	-.07	-.08	-.04	-.05	.11	-.08	.04	-.14	.17	.17	.13
	2	-.00	.39	.29	.25	.46	.37	.23	.03	.24	-.01	.00	.07
	3	-.02	.33	.18	.24	.32	.28	.19	.02	.33	-.05	.09	.20
	4	.02	.14	.14	.39	.16	.03	.04	.24	.19	.18	.04	.03
	5	-.12	.35	.27	.20	.26	.27	.30	-.07	.34	-.09	.02	.18
	6	.14	.36	.31	.12	.40	.49	.06	.04	.04	.08	.00	.06
	7	-.13	.23	.17	.27	.18	.18	.49	-.07	.25	-.15	.21	.30
	8	.26	.05	.12	.18	.02	-.02	-.05	.48	.18	.44	.17	.03
	9	-.04	.19	.16	.24	.23	.24	.29	.03	.27	.01	.12	.15
	10	.18	.02	.09	.36	.02	.01	-.29	.42	-.07	.44	.02	-.12
	11	.13	-.10	-.10	.22	-.17	.04	.25	.19	.20	.09	.58	.56
	12	.05	-.12	-.04	.12	-.19	-.01	.27	.14	.20	-.04	.58	.53

Area	Factor Item	Factor Number											
		1	2	3	4	5	6	7	8	9	10	11	12
11	1	.39	-.03	-.06	-.04	.01	-.03	-.18	.00	-.19	.12	-.17	-.21
	2	-.09	.27	.28	.12	.39	.36	.14	-.08	.01	-.02	-.11	-.01
	3	-.21	.36	.42	.15	.31	.29	.17	.01	.07	.03	.11	.18
	4	.04	.27	.15	.40	.19	.27	.27	.05	.12	.10	.14	.16
	5	.22	.10	.14	.01	.06	.05	-.25	-.02	-.29	.19	-.14	-.21
	6	.04	.25	.26	.22	.22	.30	.00	.04	-.14	.18	-.00	.02
	7	-.20	.18	-.00	.07	.11	.17	.61	-.24	.27	-.42	.26	.46
	8	.14	-.22	-.08	-.04	-.23	-.21	-.42	.21	-.28	.45	-.04	-.23
	9	-.11	.07	.16	.04	.07	.09	.16	.20	.31	.01	.17	.18
	10	.25	.01	.04	.07	.00	.08	-.36	.20	-.30	.33	-.07	-.15
	11	-.18	-.03	-.06	.12	-.08	.10	.19	.08	.15	-.06	.42	.35
	12	-.10	.19	.10	.32	.16	.28	.52	-.19	.26	-.30	.38	.51